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Evaluation of Ion Exchange Technology for Toxic and Non-Conventional Pollutant Reduction in Bleach Plant Effluents

Edward C. Jordan Co., Inc.
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EVALUATION OF ION EXCHANGE TECHNOLOGY FOR TOXIC AND NON-CONVENTIONAL POLLUTANT REDUCTION IN BLEACH PLANT EFFLUENTS

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16. ABSTRACT

This research program was designed to evaluate the applicability of ion exchange technology in reducing the pollutional effects of pulp, paper, and paperboard bleach plant effluents.

To gain some perspective on the state-of-the-art concerning ion exchange, a literature review was undertaken to assess the effectiveness of this technology in reducing toxic and non-conventional pollutants. Three ion exchange design schemes have been developed for treating bleach plant effluents: the Dow process, the Rahm & Haas process, and the Billerud Non-Polluting Bleach Plant Concept. Of these systems, only the Billerud Non-Polluting Bleach Plant Concept has been used on a full-scale basis in the pulp, paper, and paperboard industry.

Batch and pilot plant ion exchange installations of the Billerud Non-Polluting Bleach Plant Concept at Billerud Uddeholm AB in Skoghall, Sweden were evaluated as a portion of this project. This assessment was undertaken to ascertain actual operation parameters and removal efficiencies, as well as associated problems and costs. Capital, operation, and maintenance costs were projected for a full-scale computer controlled plant of the Billerud Non-Polluting Bleach Plant Concept to serve a 110,000 ton/year bleach plant.

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FOREWORD

When energy and material resources are extracted, processed, converted, and used, the related pollutional impacts on our environment and even on our health often require that new and increasingly more efficient pollution control methods be used. The Industrial Environmental Research Laboratory - Cincinnati (IERL-Ci) assists in developing and demonstrating new and improved methodologies that will meet these needs both efficiently and economically.

This report presents an evaluation of ion exchange treatment technology as it is applied to reduce the pollutional effects of pulp, paper, and paperboard industry bleach plant wastestreams. This information can be used to assess additional research needs, as well as to assess the utility of this technology for removing toxic and non-conventional pollutants at pulp, paper, and paperboard facilities.

For further information, contact the Food and Wood Products Branch, Industrial Pollution Control Division, Cincinnati, Ohio.

David G. Stephan, Director
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ABSTRACT

This research program was designed to evaluate the applicability of ion exchange technology in reducing the pollutional effects of pulp, paper, and paperboard industry bleach plant effluents.

To give some perspective on the state-of-the-art concerning ion exchange, a literature review was undertaken to assess the effectiveness of this technology in reducing toxic and non-conventional pollutants. This search revealed that weakly basic ion exchange resins, based on a phenol-formaldehyde matrix, are superior in treating pulp and paper bleach plant effluents. Additionally, the review showed that, prior to resin treatment, it is advantageous to adjust the pH and pretreat the waste stream. This pretreatment step (screening and filtration) removes macromolecular organics, which tend to foul the resin irreversibly. A pH adjustment to pH 2 to 3 has been found optimal for pollutant removal with this resin type.

Three ion exchange design schemes have been developed for treating bleach plant effluents: the Dow process, the Rohm & Haas process, and the Billerud Non-polluting Bleach Plant Concept. Of these systems, only the Billerud Non-polluting Bleach Plant Concept has been used on a full-scale basis in the pulp, paper, and paperboard industry. All are structured with the intent of minimizing chemical use and pollutant disposal costs. To this end, ion exchange systems can be economical because process streams can be used to some extent for eluting pollutants from ion exchange columns and activating the resin columns. Concentrated pollutants (eluate) can also be added to the recovery system so that a residual does not result from this treatment.

Batch and pilot plant ion exchange installations of the Billerud Non-polluting Bleach Plant Concept at Billerud Uddeholm AB in Skoghall, Sweden were evaluated as a portion of this project. This assessment was undertaken to ascertain actual operation parameters and removal efficiencies, as well as associated problems and costs. Analysis was done during this assessment to determine the removal effectiveness for 15 volatile compounds, 34 semi-volatile compounds, 13 metals, chemical oxygen demand (COD), color, chloride, and pH. Effective removal was noted for color (90 percent), COD (75 percent), chlorinated phenolics (90-100 percent), chlorinated guaiacols (80-90 percent), and some complexed metals. This treatment process did not effectively remove resin and fatty acids or phthalates.

Estimated capital cost for installing a full-scale plant to treat bleach plant wastes at a 100,000 metric ton/year facility (Kappa 35) is $4.78 million. Operation and maintenance costs are estimated at $675,000/year, giving an annual cost (assuming a ten year investment at ten percent interest) of about 1.15 million.

This report was submitted in fulfillment of Contract No. 6803-2605, Work Directive No. 6, by the E. C. Jordan Co. under the sponsorship of the U.S. Environmental Protection Agency. This report covers the period January 24, 1980 to October 1, 1980 and work was completed as of June 25, 1980.

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LIST OF ABBREVIATIONS AND SYMBOLS

ABBREVIATIONS

AB -- Aktiebolag (Swedish) joint stock company, Ltd.
ADMT -- air dry metric ton
BATEA -- Best Available Treatment Economically Achievable
BOD -- biochemical oxygen demand
BV -- bed volume
C -- chlorination stage
COD -- chemical oxygen demand
D_1 -- first chlorine dioxide stage
D_2 -- second chlorine dioxide stage
E_1 -- first caustic extraction stage
E_2 -- second caustic extraction stage
EGD/OWRS -- Effluent Guidelines Division/Office of Water Regulations and Standards
GC-MS -- gas chromatography - mass spectrometry
gpm/ft^3 -- gallons per minute per cubic foot
H -- hypochlorite stage
hr -- hour
HVAC -- heating, ventilation and air conditioning
IERL -- Industrial Environmental Research Laboratory
kg -- kilogram
kg/cm^2 -- kilograms per square centimeter
KWH -- kilowatt hour
lb -- pound
lbs/ft^3 -- pounds per cubic foot
m^3 -- cubic meters
ml -- milliliters
moles/l -- moles per liter
NC -- no change
ND -- not detected
nm -- nanometers
NS -- not sampled
TDS -- total dissolved solids
TOC -- total organic carbon
USEPA-EGD -- United States Environmental Protection Agency - Effluent Guidelines Division
°C -- degrees centigrade
µg/l -- micrograms per liter
< -- less than
> -- greater than

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SECTION 1

INTRODUCTION

The U.S. Environmental Protection Agency Effluent Guidelines Division (USEPA-EGD) is currently reviewing effluent limitations guidelines for the Best Available Treatment Technology Economically Achievable (BATEA) in the pulp, paper, and paperboard industry point source category. New technologies that appear applicable to this point source category are being evaluated.

The patented Swedish ion exchange technology in use at the Billerud Uddeholm AB mill in Skoghall, Sweden has been cited as a new technology which may provide cost-effective wastewater treatment for the pulp, paper, and paperboard industry. The Billerud Uddeholm AB mill produces a variety of products including market pulp, bleached specialty grades, unbleached kraft sack paper and folding boxboard. The pulping processes include dissolving sulfite, kraft and thermo-mechanical pulps. The production rates are as shown in Table 1.

TABLE 1. PRODUCTION AT BILLERUD UDDEHOLM AB

Dissolving sulfite (alpha content 93-94%)	80,000 metric tons/yr
Kraft	300,000 metric tons/yr
unbleached 190,000 tons/yr	
bleached 110,000 tons/yr	
Thermo-mechanical	65,000 metric tons/yr

The patented process consists of dual resin columns operating in series in which the first, or primary, is a roughing unit, and the second a scavenger. At breakthrough (the point at which the available capacity is saturated with pollutants), the roughing unit is eluted, reactivated, and becomes the secondary or scavenging unit, while the scavenging unit becomes the primary or roughing unit. This cycle repeats itself, allowing effective pollutant removal. Appendix A contains, in general terms, a description of sorption and ion exchange processes.

The Swedish Government has established effluent limitations for color at the Billerud Uddeholm AB facility in Skoghall. This pollutant is controlled strictly because the mill is located on and discharges into a lake which cannot assimilate the color load, but can assimilate the BOD or COD load. The government has limited the color discharge to 10 percent of the initial color (i.e., 90 percent must be removed). Billerud Uddeholm AB has also agreed to remove 90 percent of the chlorinated organics, but this is not considered an effluent limitation. The batch ion exchange system was installed initially because it enabled Billerud Uddeholm AB to meet this color limitation. It was discovered later that the system removed additional pollutants, a discovery which led to considerable interest in the system.

Preliminary data indicates that the treatment system reduces chlorinated phenols by 95 to 99 percent, color by approximately 90 percent, and chemical oxygen demand (COD) by approximately 70 percent. A sales license for the concept is held in this country by Kamyr, Inc.

Billerud Uddeholm AB has operated a full-scale batch system since 1973 and a large micro-processor controlled continuous pilot plant since 1976. After seven years of good experience with these systems, the management decided to build a full-scale continuous plant. This system has been constructed, and Billerud Uddeholm AB personnel are fine-tuning it.

One distinct advantage offered by this technology over comparable technologies is the concentrated organic waste stream obtained after the exchange columns have been eluted can be concentrated further and burned, generating approximately 20 kg of steam for each metric ton of pulp produced.

This report summarizes an evaluation undertaken by the E. C. Jordan Co. for the Food and Wood Products Branch of IERL. This project was supported by EGD/OWRS with the intent of obtaining data on the potential for removal of toxic and nonconventional pollutants from pulp, paper, and paperboard wastewaters using ion exchange technology, a technology not applied on a full-scale basis in the United States pulp, paper, and paperboard industry. This evaluation assesses the practicability of this technology (as in the Billerud Uddeholm AB mill) for removing toxic and nonconventional pollutants including color and will provide basic information necessary to determine the applicability of this technology at a given mill complex. Of course, prior to any full-scale application, detailed research must be conducted at all mills where this treatment technique appears useful.

Use of this treatment technology in the United States may be limited by a number of factors. Firstly, the extensive research undertaken in Sweden has been done with a primary interest in removal of color. Currently, color is not of concern in the United States and is not expected to be in the future. Therefore, except where color removal is paramount, the system developed in Sweden is not immediately transferable. Secondly, ion exchange treatment does not remove a sufficient amount of organic matter, measured as BOD, to be used as the only treatment; biological treatment is necessary in conjunction with ion exchange. Low rate biological treatment has been shown to remove portions of the toxic waste load (1) and, perhaps this system could produce an effluent in which the pollutional load has been reduced sufficiently to meet current standards.

Initially, a literature review (Appendix B) was undertaken and such sources as computer assisted searches, pulp and paper journals, research publications, and textbooks were consulted in gathering available research material pertinent to ion exchange use in pulp, paper, and paperboard facilities. This material was reviewed to determine the state-of-the-art of ion exchange treatment as applied to complex waste streams, and to obtain some idea of its usability in reducing the pollutants of concern.

The assessment phase of the project included six sampling programs. These programs were organized as shown in Table 2. The E. C. Jordan Co. subcontracted with the Radian Corporation, Austin, Texas, to do analysis, as well as assist in sampling. A report of Radian's detailed results can be found in Appendix C. This contains descriptions of the sampling and analysis procedures, detailed sampling results, and a quality control summary.

After the lierature review had been completed, a screening analysis program was undertaken at the Billerud Uddeholm AB plant in Skoghall, Sweden. During this program, researchers selected the compounds to be evaluated in the more detailed sampling programs, established the spiking levels for the surrogate compounds, and finalized the laboratory analysis procedures. The pollutants analyzed during the detailed sampling and analysis programs are listed in Table 3.

During the detailed sampling programs of the batch and pilot plant systems, bleach plant operating parameters were monitored. This was done to determine how closely this plant was operating to a steady state system.

The final portion of this study was the actual sampling and analysis of effluents from the batch and pilot plant ion exchange systems. Both systems were assessed carefully by measuring the removal efficiency of each column. Detailed explanations of each sampling program can be found in Sections 6 and 7 of this report. Reference should be made to these sections for a description of the sampling program, as well as a report of the analytical results.

TABLE 2. SUMMARY OF SAMPLING PROGRAMS

Program	Plant sampled	Sampling time	Operation Mode	Sample type	Purpose of program
Screening	batch plant	2/13/80	normal	grab	Finalize analysis methods and determine pollutant types and concentrations
1	batch plant	2/26/80 (2 hr)	normal	manual composite and grab	Determine removal efficiency and efficiency reduction through cycle
2	batch plant	3/4/80 (9 hr)	normal	manual composite	Determine average removal efficiencies through cycle
3	pilot plant	3/4/80 (5½ hr)	normal	manual composite	Determine average removal efficiencies through cycle
4	pilot plant	3/5/80 (8 hr)	normal	manual composite	Determine average removal efficiencies through cycle
5	pilot plant	3/5/80 (4 hr)	normal	series of manual composites	Determine a single columns' removal efficiency through a cycle and the strong eluate pollutant content
6	pilot plant	3/6/80 (6 hr)	extended	series of manual composites	Determine removals when cycle time is extended beyond optimal

TABLE 3. COMPOUNDS STUDIED AT THE BILLERUD UDDEHOLM AB MILL

Volatile Organics

Methylene chloride
Trichlorofluoromethane
1,1-Dichloroethane
Chloroform
1,2-Dichloroethane
1,1,1-Trichloroethane
Bromodichloromethane
Trichloroethylene
Dibromochloromethane
Benzene
1,1,2,2-Tetrachloroethane
Tetrachloroethylene
Toluene
Chlorobenzene
Ethylbenzene

Semi-volatile Organics

Phenol
Isophorone
Naphthalene
Hexachlorobutadiene
2,4-Dichlorophenol
2,4,6-Trichlorophenol
2,3,5-Trichlorophenol
Diethyl phthalate
Trichloroguaiacol
4-Bromophenyl phenyl ether
Tetrachloroguaiacol
Pentachlorophenol
Phenanthrene/Anthracene
Dibutyl phthalate
Heptadecanoic acid
Fluoranthene
Linoleic acid (C18:2)
Linolenic acid (C18:3)
Pyrene
Pimaric acid
Sandracopimaric acid
Isopimaric acid
Dehydroabietic acid
Abietic acid
Heneicosanoic acid (C21:0)
Chrysene
Chlorodehydroabietic acid (Isomer A)
bis (2-Ethylhexyl) phthalate
Chlorodehydroabietic acid (Isomer B)
Dichlorodehydroabietic acid (unknown isomer)
Dioctyl phthalate
Neoabietic acid
9,10-Dichlorostearic acid

Metals

Sb - Antimony
As - Arsenic
Be - Beryllium
Cd - Cadmium
Cr - Chromium
Cu - Copper
Pb - Lead
Ni - Nickel
Se - Selenium
Ag - Silver
Tl - Thallium
Zn - Zinc
Hg - Mercury

TABLE 3 - continued

Other

COD - Chemical Oxygen Demand
Color
Chloride
pH

Internal Standard Spikes

Volatile	Semi-Volatile
d4-1,4,-Dichloroethane	Pentafluorophenol
d6-Benzene	d8-Naphthalene
d8-Toluene	d35-Stearic acid

SECTION 2

CONCLUSIONS

The batch and pilot scale ion exchange plants at Billerud Uddeholm AB in Skoghall, Sweden effectively remove color, COD, chlorinated phenols, chlorinated guaiacols and some complexed metals (Table 4). This assessment showed that resin and fatty acids and phthalates are not removed. Inorganic chloride is removed initially but drops off shortly after the cycle starts.

Zinc and copper are removed, perhaps through chelation processes. Cadmium and nickel appear to be removed effectively in the second column, but are virtually untouched in the first. The removal efficiency of the chlorinated phenols and guaiacols increases toward the end of the treatment cycle, a phenomenon most likely caused by adsorption in organic materials that build up on the resin during the ion exchange process.

Extended contact time yielded no benefits. Effective removal was lost rapidly and significant pollution was passed through the treatment columns.

Generally, the first column removes compounds with high charge densities and allows the remaining compounds to pass onto the second column. This column becomes saturated with weakly bound compounds which are eluted by the wastestream when this column is transferred to the first position, thereby showing a pollutant increase across the column.

The projected capital cost for a full-scale ion exchange plant to treat flows from a 100,000 metric ton/yr bleach plant bleaching pulp with a kappa number of 35 is $4.78 million. The annual operation costs are estimated to be between $513,000 and $564,500 (depending on the resin life). Maintenance costs are $83,000/yr and labor costs are $51,000/yr.

Design of an ion exchange adsorption system may be complicated by a number of factors but if these complications can be overcome, and the initial capital cost accepted, this system may be economically superior to other technologies currently available.

TABLE 4. AVERAGE POLLUTANT REDUCTION (PERCENT) DURING SAMPLING PROGRAMS

Pollutant	Batch plant			Pilot plant			
	Screening	Program 1	Program 2	Program 3	Program 4	Program 5*	Program 6
Volatile Organics							
Methylene chloride	ND	+	+	100	78	41	ND
Trichlorofluoromethane	ND	ND	ND	ND	ND	ND	ND
1,1-dichloroethane	+	ND	ND	ND	ND	ND	ND
Chloroform	50	35	9	34	31	5	35
1,2-dichloroethane	ND	ND	ND	ND	ND	ND	ND
1,1,1-trichloroethane	ND	ND	ND	ND	ND	ND	ND
Bromodichloromethane	42	65	51	56	100	61	+
Trichloroethylene	+	+	+	+	+	+	+
Dibromochloromethane	ND	ND	ND	ND	ND	ND	ND
Benzene	100	+	13	33	42	+	+
1,1,2,2-tetrachloroethane	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethylene	+	13	+	100	+	11	26
Toluene	+	+	45	+	+	40	+
Chlorobenzene	ND	ND	ND	ND	ND	+	ND
Ethylbenzene	ND	ND	ND	ND	ND	ND	ND
Semi-Volatile Organics							
Phenol	100	ND	ND	ND	ND	ND	ND
Isophorone	ND	ND	ND	ND	ND	ND	ND
Naphthalene	ND	ND	ND	ND	ND	ND	ND
Hexachlorobutadiene	24	ND	ND	ND	ND	ND	ND
2,4-dichlorophenol	98	100	100	100	100	98	100
2,4,6-trichlorophenol	98	99	99	94	88	62	93
2,3,5-trichlorophenol	ND	100	100	100	100	100	ND
Diethyl phthalate	100	ND	ND	ND	ND	ND	ND
Trichloroguaiacol	ND	88	97	89	78	81	91
4-bromophenyl phenyl ether	100	ND	ND	ND	ND	ND	ND
Tetrachloroguaiacol	ND	82	89	78	82	79	92
Pentachlorophenol	14	ND	ND	ND	ND	ND	ND
Phenanthrene/anthracene	ND	ND	ND	ND	ND	ND	ND

TABLE 4 (Continued)

Pollutant	Batch plant Screening	Batch plant Program 1	Batch plant Program 2	Pilot plant Program 3	Pilot plant Program 4	Pilot plant Program 5*	Pilot plant Program 6
Semi-Volatile Organics (continued)							
Dibutyl phthalate	8	+	53	6	+	71	+
Heptadecanoic acid	ND	74	21	+	+	+	77
Fluoranthene	ND	ND	ND	ND	ND	ND	ND
Linoleic acid (C18:2)	ND	ND	ND	ND	ND	ND	ND
Linolenic acid (C18:3)	ND	ND	ND	ND	ND	ND	ND
Oleic acid (C18:1)	ND	ND	ND	ND	ND	ND	ND
Pyrene	ND	ND	ND	ND	ND	ND	ND
Pimaric acid	ND	ND	ND	ND	ND	ND	ND
Sandracopimaric acid	ND	ND	ND	ND	ND	ND	ND
Isopimaric acid	ND	ND	ND	ND	ND	ND	ND
Dehydroabietic acid	ND	85	87	+	48	29	61
Abietic acid	ND	ND	ND	ND	ND	ND	ND
Heneicosanoic acid (C21:0)	ND	+	ND	100	ND	35	100
Chrysene	ND	ND	ND	ND	ND	ND	ND
Chlorodehydroabietic acid (Isomer A)	ND	16	57	+	+	+	61
bis(2-ethylhexyl)phthalate	+	+	95	+	86	+	+
Chlorodehydroabietic acid (Isomer B)	ND	6	38	+	+	+	62
Dichlorodehydroabietic acid (unknown isomer)	ND	+	32	+	+	+	+
Dioctyl phthalate	ND	ND	ND	ND	ND	ND	+
Neoabietic acid	ND	ND	ND	ND	ND	ND	ND
9,10-dichlorostearic acid	ND	58	30	+	+	+	+
Metals							
Antimony	NS	+	+	NS	NS	NS	NS
Arsenic	NS	+	+	63	67	70	50
Beryllium	NS	NS	NS	NS	NS	NS	NS
Cadmium	NS	38	42	100	100	79	100
Chromium	NS	18	5	59	47	42	24

TABLE 4 (Continued)

Pollutant	Batch plant			Pilot plant			
	Screening	Program 1	Program 2	Program 3	Program 4	Program 5*	Program 6
Metals (continued)							
Copper	NS	60	24	72	82	75	82
Lead	NS	33	75	67	50	+	50
Nickel	NS	4	+	83	+	43	74
Selenium	NS	+	+	20	33	7	33
Silver	NS	+	+	62	17	31	50
Thallium	NS	NS	10	+	39	45	40
Zinc	NS	61	51	31	94	15	39
Mercury	NS	54	+	57	38	37	60
Other							
COD	NS	66	65	67	77	68	75
Color	NS	77	69	90	90	85	90
Chloride	NS	18	13	+	+	+	+
pH change	NS	3.4-6.7	3.4-6.2	3.3-2.8	3.2-2.8	3.4-2.93	3.2-2.9

Notes: See Table 2 for a description of the sampling programs.

*Due to the organization of Program 5, adequate samples were not taken to determine the average overall removal efficiency without a small incurred error.

$$\text{Overall Percent Removal} = \frac{\text{Component Concentration in Column \#1 Feed - Comp. Conc. in Col. \#2 Discharge}}{100}$$

NS - Not sampled
ND - Not detected
+ - Increase noted

SECTION 3

RECOMMENDATIONS

A verification program to assess operation parameters, capital costs, and operation and maintenance costs will be possible once the full-scale continuous plant is optimized and operated for a period of time at Billerud Uddeholm AB. It is recommended that a program of this type be undertaken as a final assessment stage of the Billerud Uddeholm Non-polluting Bleach Plant Concept.

Additional work is recommended to obtain data usable to calculate a mass balance through this system for all compounds tested. This would lead to a higher confidence level in the figures denoting removal effectiveness. A mobile pilot plant setup for use in the United States may be a desirable aid in this study. The plant could be used to assess the applicability of ion exchange treatment in all industries.

It may be desirable to artificially inject known concentrations of pollutants to this pilot plant system and monitor the removal response of different resins in different treatment configurations at different resin ages. This data would be very useful in assessing the effectiveness of different resins in different configurations. As an example, it is postulated that use of basic ion exchange resins after this treatment would remove resin and fatty acids (pH neutralization would be necessary between these operations). The effectiveness and economics of this system should be assessed to determine its efficiency for cleaning bleach plant and other wastes.

SECTION 4

PRELIMINARY SCREENING

INTRODUCTION

A preliminary screening analysis was undertaken prior to initiating the detailed technology assessment phase of this study. There were three objectives of this preliminary analysis:

- determine the concentration range of various compounds at each sample point to provide information regarding spiking levels for surrogate compounds;
- determine whether any additional toxic pollutants should be added to the preliminary list developed during the BATEA review program for the pulp, paper, and paperboard industry; and
- evaluate the proposed methodology on the sample matrix to determine whether procedural modifications would be required.

The Billerud Uddeholm AB staff conducted the sampling, extracting, concentrating, preserving and shipping. Grab samples were collected at each of the following locations on February 13, 1980:

- mill influent;
- influent to ion exchange treatment; and
- effluent from ion exchange treatment.

The samples were acidified, extracted with methylene chloride, and concentrated using a Kuderna-Danish (K-D) concentrator. These concentrated extracts were shipped to the Radian Corporation for analysis along with eight corresponding 15 ml vials of water for determining the type and concentration of the volatile organic compounds. These samples were analyzed by gas chromatography-mass spectrometry (GC-MS), according to the EPA screening protocol (2).

Table 5 presents the compounds routinely tested for throughout the remainder of this program. This list was generated by analysis of the screening samples for EPA's toxic pollutants and other compounds, as well as additional testing for unique compounds. The pollutants that had been found

TABLE 5. COMPOUNDS STUDIED AT THE BILLERUD UDDEHOLM AB MILL

Volatile Organic Compounds

Methylene chloride
Trichlorofluoromethane
1,1-Dichloroethane
Chloroform
1,2-Dichloroethane
1,1,1-Trichloroethane
Bromodichloromethane
Trichloroethylene
Dibromochloromethane
Benzene
1,1,2,2-Tetrachloroethane
Tetrachloroethylene
Toluene
Chlorobenzene
Ethylbenzene

Semi-volatile Organic Compounds

Phenol
Isophorone
Naphthalene
Hexachlorobutadiene
2,4-Dichlorophenol
2,4,6-Trichlorophenol
2,3,5-Trichlorophenol
Diethyl phthalate
Trichloroguaiacol
4-Bromophenyl phenyl ether
Tetrachloroguaiacol
Pentachlorophenol
Phenanthrene/Anthracene
Dibutyl phthalate
Heptadecanoic acid
Fluoranthene
Linoleic acid (C18:2)
Linolenic acid (C18:3)
Pyrene
Pimaric acid
Sandracopimaric acid
Isopimaric acid
Dehydroabietic acid
Abietic acid
Heneicosanoic acid (C21:0)
Chrysene
Chlorodehydroabietic acid (Isomer A)
bis (2-Ethylhexyl) phthalate
Chlorodehydroabietic acid (Isomer B)
Dichlorodehydroabietic acid (unknown isomer)
Dioctyl phthalate
Neoabietic acid
9,10-Dichlorostearic acid

Metals

Sb - Antimony
As - Arsenic
Be - Beryllium
Cd - Cadmium
Cr - Chromium
Cu - Copper
Pb - Lead
Ni - Nickel
Se - Selenium
Ag - Silver
Tl - Thallium
Zn - Zinc
Hg - Mercury

TABLE 5 - continued

Other

COD - Chemical Oxygen Demand
Color
Chloride
pH

Internal Standard Spikes

Volatile	Semi-Volatile
d4-1,4,-Dichloroethane	Pentafluorophenol
d6-Benzene	d8-Naphthalene
d8-Toluene	d35-Stearic acid

previously in the pulp, paper, and paperboard industry or that were found in the screening analysis are included in Table 5 and were routinely tested.

Results and Discussion

The results of the volatile and semi-volatile organics analyses for the screening phase of this program are presented in Tables 6 and 7, respectively. Reference to these tables indicates removal of chloroform (50 percent) and a substantial removal (greater than 90 percent) of 2,4-dichlorophenol and 2,4,6-trichlorophenol. The other compounds were at or near the detection limits of the analysis, making estimates of the removal efficiency by ion exchange treatment difficult. Reference should be made to Tables 8 and 9 for an account of the experimental limitations of these test procedures.

The chlorophenolic compounds appear to be generated in the chlorination stage of the bleach plant and are released (about 90 percent) in the first extraction stage washer. These compounds appear to be formed in the bleachery, since slimicides containing phenolic compounds are not used at this plant.

TABLE 6

Screening Program

Volatile Organics, µg/l

	1,1-Dichloroethane	Chloroform*	Bromodichloromethane	Trichloroethylene	Benzene	Tetrachloroethylene	Toluene
Mill Influent	ND	39	2.5	4.9	ND	1.6	ND
Ion Exchange Influent	ND	92000	5.5	4.9	1.1	1.8	1.3
Ion Exchange Effluent	1.4	46000	3.2	5.0	ND	2.6	1.9

Note: *Done by direct injection
ND - Not detected

TABLE 7

Screening Program

Semi-Volatile Organics, µg/l

	Phenol	Hexachlorobutadiene	2,4-Dichlorophenol	2,4,6-Trichlorophenol	Diethylphthalate	4-Bromophenyl Phenyl Ether	Pentachlorophenol	Dibutyl phthalate	bis (2-Ethylhexyl) phthalate
Mill Influent	ND	6.2	ND	ND	ND	ND	ND	1.7	11
Ion Exchange Influent	6.1	7.2	59	160	1.5	8.8	10	1.3	1.8
Ion Exchange Effluent	ND	5.5	1.4	2.7	ND	ND	8.6	1.2	2.8

Note: ND - Not detected

TABLE 8. SUMMARY OF RADIAN DETECTION LIMITS FOR THE ORGANIC PRIORITY POLLUTANTS IN CLEAN WATER*

Parameter	Detection limit, mg/l*	Parameter	Detection limit, mg/l*
Volatile Organics			
		Naphthalene	0.001
Acrolein	0.003	2-Chloronaphthalene	0.001
Acrylonitrile	0.002	Isophorone	0.001
Benzene	0.001	Nitrobenzene	0.002
Toluene	0.001	2,4-Dinitrotoluene	0.010
Ethylbenzene	0.001	2,6-Dinitrotoluene	0.010
Carbon tetrachloride	0.001	4-Bromophenyl phenyl ether	0.002
Chlorobenzene	0.001	bis(2-Ethylhexyl)phthalate	0.001
1,2-Dichloroethane	0.003	Di-n-octyl phthalate	0.001
1,1,1-Trichloroethane	0.001	Dimethyl phthalate	0.001
1,1-Dichloroethane	0.001	Diethyl phthalate	0.001
1,1-Dichloroethylene	0.001	Di-n-butyl phthalate	0.001
1,1,2-Trichloroethane	0.001	Acenaphthylene	0.001
1,1,2,2-Tetrachloroethane	0.001	Acenaphthene	0.001
Chloroethane	0.050	Butyl benzyl phthalate	0.001
2-Chloroethyl vinyl ether	0.002	Phenol	0.001
Chloroform	0.001	2-Nitrophenol	0.001
1,2-Dichloropropane	0.001	4-Nitrophenol	0.001
1,3-Dichloropopene	0.001	2,4-Dinitrophenol	0.001
Methylene chloride	0.001	4,6-Dinitro-o-cresol	0.001
Methyl chloride	0.100	Pentachlorophenol	0.002
Methyl bromide	0.100	Fluorene	0.001
Bromoform	0.001	Fluoranthene	0.001
Dichlorobromomethane	0.001	Chrysene	0.001
Trichlorofluoromethane	0.002	Pyrene	0.001
Dichlorodifluoromethane	0.050	Phenanthrene	0.001
Chlorodibromomethane	0.003	Anthracene	0.001
Tetrachloroethylene	0.001	Benzo(a)anthracene	0.001
Trichloroethylene	0.001	Benzo(b)fluoranthene	0.001
Vinyl chloride	0.050	Benzo(k)fluoranthene	0.001
1,2-trans-Dichloroethylene	0.001	Benzo(a)pyrene	0.001
bis(Chloromethyl)ether	0.005	Ideno(1,2,3-c,d)pyrene	0.001
		Dibenzo(a,h)anthracene	0.001
		Benzo(g,h,i)perylene	0.001
		4-Chlorophenyl phenyl ether	0.001
		3,3-Dichlorobenzidine	0.001
		Benzidine	0.001
Semi-Volatile Organics		bis(2-Chloroethyl)ether	0.001
		1,2-Dipheylhydrazine	0.001
1,2-Dichlorobenzene	0.001	Hexachlorocyclopentadiene	0.001
1,3-Dichlorobenzene	0.001	N-Nitrosodipheylamine	0.001

TABLE 8 - continued

Parameter	Detection limit, mg/l*	Parameter	Detection limit, mg/l*
1,4-Dichlorobenzene	0.001	N-Nitrosodi-n-propylamine	0.001
Hexachloroethane	0.002	bis(2-Chloroisopropyl)ether	0.001
Hexachlorobutadiene	0.002	p-Chloro-m-cresol	0.002
Hexachlorobenzene	0.001	2-Chlorophenol	0.001
1,2,4-Trichlorobenzene	0.001	2,4-Dichlorophenol	0.001
bis(2-Chloroethoxy)methane	0.002	2,4,6-Trichlorophenol	0.002
		2,4-Dimethylphenol	0.001

*5 ml VOA sample; concentration factor 1000 for extractable organics

TABLE 9. SUMMARY OF RADIAN DETECTION LIMITS FOR THE RESIN ACIDS IN CLEAN WATER

Semi-volatile organics*	Detection limit, mg/l
2,3,5-Trichlorophenol	0.003
Trichloroguaiacol	0.005
Heptadecanoic acid	0.010
Tetrachloroguaiacol	0.004
Linoleic acid	0.010
Linolenic acid	0.010
Oleic acid	0.010
Pimaric acid	0.003
Sandracopimaric acid	0.002
Isopimaric acid	0.003
Dehydroabietic acid	0.001
Abietic acid	0.006
Heneicosanoic acid	0.020
Chlorodeydroabietic acid (Isomer A)	0.001
Chlorodehydroabietic acid (Isomer B)	0.001
Dichlorodehydroabietic acid	0.002
Neoabietic acid	0.003
9,10-Dichlorostearic acid	0.003

*Detection limits are based upon their methylated esters.

SECTION 5

BLEACH PLANT OPERATIONS DURING SAMPLING PROGRAMS

The bleach plant operation was monitored during the sampling of the pilot and batch plant ion exchange systems. This monitoring program was arranged to assure normal operation of this facility during the testing program. During the sampling periods, hourly records were obtained describing bleach plant production, chemical use, stock temperature, pH, and brightness. The wood species pulped are normally 70 percent pine and 30 percent spruce. The kraft pulp mill operates at 42-47 percent sulfidity (normally 44 percent) and yields a pulp with a Kappa number of 35. The soda loss from the pulping operation is approximately 90 lb Na_2SO_4/ton of pulp produced. The recovery in the kraft operation is slightly better than 98 percent while in the sulfite operation it is about 91 percent (3).

The results of this monitoring program are presented in Table 10. These show bleach plant production to be slightly below normal for the sampling program on February 26, 1980, but at normal levels for the rest of the technical assessment.

TABLE 10. BLEACH PLANT OPERATING DATA

			Chlorination stage		Caustic extraction stage			
Date & time	Production (metric tons/hour)	Pulp brightness	Chemical usage (kg/hr)	Temperature (°C)	pH	Chemical usage (kg/hr)	Temperature (°C)	Flow (m^3/hr)
2/26/80								
0600	-	-	-	-	11.0	300.0	-	-
0700	-	90.0	-	-	11.0	300.0	-	-
0800	10.0	-	900.0	34	11.0	300.0	60°	156
0900	10.0	90.0	950.0	34	11.0	300.0	60°	192
1000	12.0	-	950.0	34	11.0	460.0	60°	200
1100	11.0	78.7	900.0	34	10.0	460.0	60°	180
1200	11.0	-	900.0	34	10.7	400.0	60°	188
1300	12.0	-	900.0	33	10.5	360.0	60°	196
1400	12.0	-	850.0	33	11.0	360.0	60°	176
1500	12.0	87.5	850.0	33	11.4	360.0	60°	176
1600	13.0	-	850.0	33	10.5	360.0	60°	190
3/04/80								
0600	13.0	-	750.0	36-37	12.0	360.0	60°	-
0700	13.0	88.0	850.0	36-37	11.1	360.0	60°	-
0800	13.0	-	800.0	36-37	10.8	380.0	60°	-
0900	13.0	89.0	800.0	36-37	11.0	380.0	60°	-
1000	13.0	-	750.0	36-37	11.1	380.0	60°	-
1100	13.0	89.0	700.0	36-37	11.1	380.0	60°	-
1200	13.0	-	900.0	36-37	10.7	400.0	60°	164
1300	13.0	88.2	900.0	36-37	10.8	400.0	60°	164
1400	13.0	-	950.0	36-37	10.6	400.0	60°	158
1500	13.0	86.6	775.0	36-37	11.1	380.0	60°	156
1600	13.0	-	950.0	36-37	10.4	420.0	60°	160
1700	13.0	86.2	900.0	36-37	10.6	420.0	60°	160
1800	13.0	-	1000.0	36-37	-	420.0	60°	165

TABLE 10 - continued

Date & time	Production (metric tons/hour)	Pulp brightness	Chlorination stage		Caustic extraction stage			
			Chemical usage (kg/hr)	Temperature (°C)	pH	Chemical usage (kg/hr)	Temperature (°C)	Flow (m^3/hr)
3/05/80								
0600	13.0	-	820.0	36	11.1	360.0	60°	-
0700	13.0	87.1	880.0	36	10.8	360.0	60°	-
0800	13.0	-	900.0	35	10.8	380.0	60°	-
0900	13.0	88.4	920.0	35	10.6	400.0	60°	156
1000	13.0	-	900.0	34	10.4	380.0	60°	128
1100	8.0	88.1	-	-	-	-	-	74
1200	13.0	-	850.0	34	10.8	400.0	55°	160
1300	13.0	88.9	850.0	30	11.6	400.0	60°	160
1400	13.0	-	850.0	31	11.2	400.0	60°	160
1500	13.0	88.8	800.0	36	11.2	400.0	60°	160
1600	13.0	-	925.0	34	11.0	380.0	60°	160
1700	13.0	90.1	850.0	35	10.6	400.0	60°	160
1800	13.0	-	800.0	36	10.4	400.0	60°	160
3/06/80								
0600	13.0	-	925.0	35	11.2	380.0	60°	180
0700	13.0	89.4	950.0	35	11.0	380.0	60°	180
0800	13.0	-	900.0	34	11.0	380.0	60°	180
0900	13.0	89.5	900.0	34	11.2	380.0	60°	180
1000	13.0	-	900.0	34	10.6	380.0	60°	180
1100	13.0	88.0	800.0	33	10.7	380.0	60°	180
1200	13.0	-	800.0	32	11.3	360.0	60°	180
1300	13.0	88.9	800.0	33	11.0	360.0	60°	180
1400	13.0	-	875.0	34	10.3	380.0	60°	180
1500	13.0	89.1	900.0	34	10.4	380.0	60°	180

SECTION 6

BATCH PLANT TECHNICAL ASSESSMENT

DESCRIPTION OF BATCH PLANT

Based on initial studies by Billerud Uddeholm AB personnel, an ion exchange system for color removal was constructed and started up in 1973. The "core" of the system consists of three old batch digesters which had been replaced by continuous digesters. The system is made up of the following components:

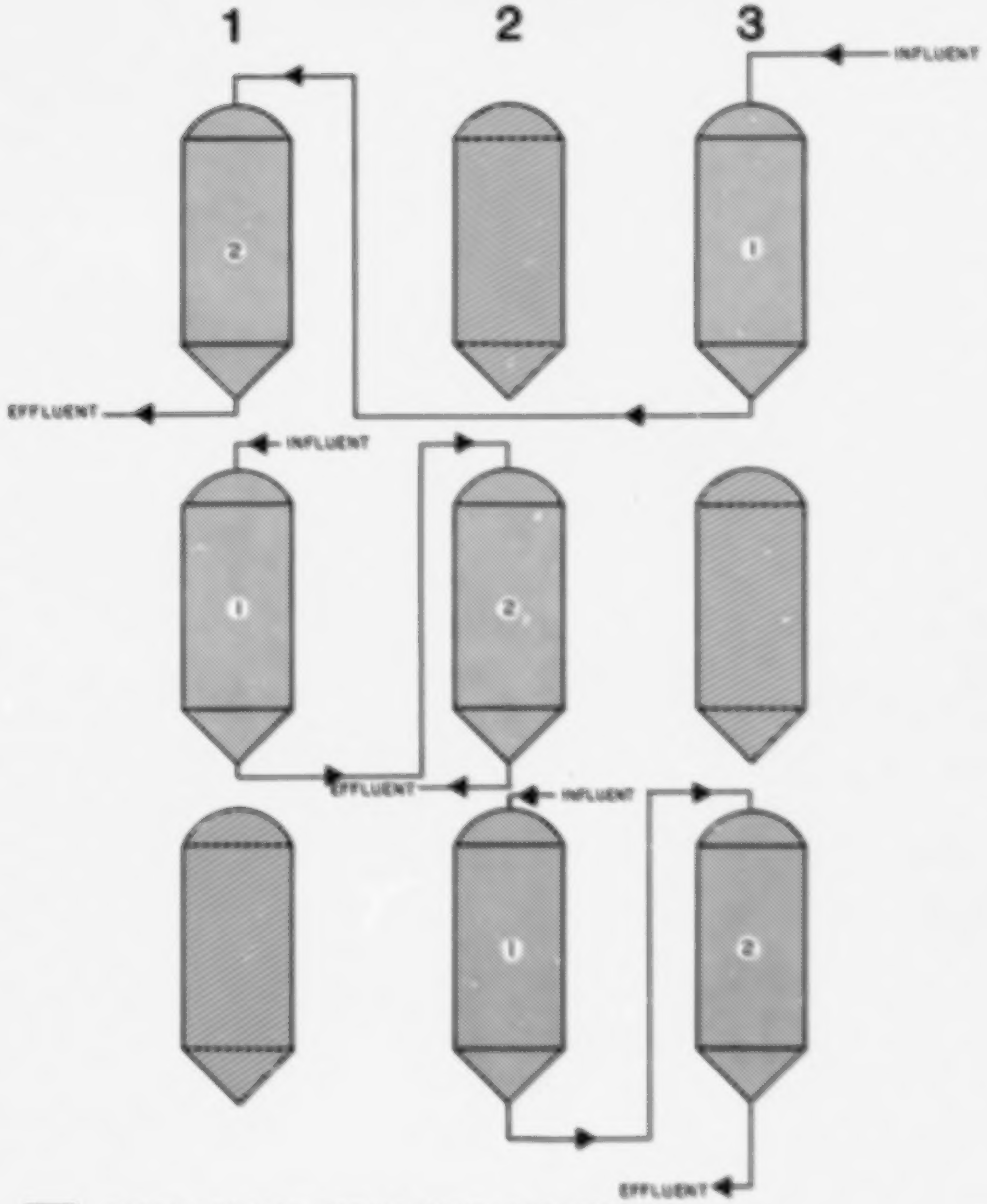
1. Prefilters (20 mesh screens)
2. Storage tank
3. Sand filters
4. Storage tank
5. Ion exchange columns

The digesters are made of mild steel and have conical bottoms. Sand was added to the conical section of the digesters as a support media. A collection mechanism was added above this with the resin placed directly above this. The mild steel was coated with rubber in an effort to inhibit corrosion. The state of the mild steel was such that a good bond was not obtained between the old, corroded steel and the rubber. Thus, the rubber peeled off in places and corrosion resulted. Because of this, the mill has had to replace all of the conical bottoms with stainless steel. The sand-supporting media has not been damaged in the seven years of use.

Each column or digester has a volume of 60 cubic meters; normally two of the columns are operated in series. The system treats the first extraction stage of the bleach plant and operates to achieve an overall average color removal of 90 percent. A cycle is "broken" when the color removal drops to 70 percent. When this occurs, the primary or roughing column is removed from service and eluted. The secondary or scavenging column becomes the primary column and the recently reactivated column serves as the secondary column. This operational mode is outlined in Figure 1.

Each column contains between 17 and 20 cubic meters of resin. In July 1979 mill staff removed the resin in one of the columns and divided the resin in the other two columns between the three columns. Each column now contains approximately 13.1 cubic meters of resin. The flow through the system is approximately five bed volumes per hour and the cycle time (treatment time between changes in flow scheme) is three hours.

FIGURE 1
ION–EXCHANGE BATCH PLANT OPERATION
BED SEQUENCING


1
2
3
INFLUENT
②
①
EFFLUENT
INFLUENT
①
②
EFFLUENT
INFLUENT
①
②
EFFLUENT

① FIRST EXTRACTION STAGE CLEANING & BED POSITION

▨ ELUTION & CLEANING

When a column is removed from service for resin reactivation, caustic and rinse water are first introduced. Caustic is added (0.2 bed volumes) followed by 0.7-0.8 bed volumes of removed rinse water. The resulting flow is called "weak eluate." This is recycled back to the influent to the ion exchange columns that are in the treatment mode. A photometer is used to "sense" when the eluate should be termed "strong eluate" and sent to evaporation. Fresh water follows the initial recovered rinse in the elution process and the eluate is concentrated and called "strong eluate." The strong eluate, which is 0.8-0.9 bed volumes, is combined with the black liquor for evaporation and recovery. A timer is used to determine how long the strong eluate is sent to recovery. After the 0.8-0.9 bed volumes the eluate becomes "weak" again. The final bed volume of elution water is weak eluate, which is stored and used later as removed rinse water at the beginning of the next elution process.

This process is shown diagramatically in Figure 2 and the eluate concentration change is shown graphically in Figure 3.

After the elution process, the resin is reactivated with an acid solution (either sulfuric acid or sulfur dioxide).

The system described above is currently treating 70 cubic meters/hr or about 50 percent of the first extraction stage effluent. The remaining 50 percent is sent to the sewer. Treatment of this portion of the effluent allows Billerud Uddeholm AB to meet its discharge limitations. The pH of the first extraction stage effluent is adjusted to between three and four prior to the ion exchange process. The strong eluate, which is sent to evaporation and recovery, contains 4 percent solids and uses up to 5 percent of the recovery capacity.

Once the full-scale batch system had been operating, the Billerud Uddeholm AB personnel developed the "Non-polluting Bleach Plant Concept" which includes "close up" of the bleach plant as shown in Figure 4. After a large-scale pilot plant operation and other studies, a full-scale system was designed. Billerud Uddeholm AB personnel are fine tuning this system which was started up in early December of 1980.

SAMPLING PROCEDURE

Program Number 1

On Tuesday, February 26, 1980, samples were obtained from the full-scale ion exchange batch plant for the first stage of the technical assessment of this operation. The samples were obtained during a two-hour (1015-1215) period in the middle of the three-hour resin cycle (0935-1235). The cyclic operation of this batch plant is explained in detail in the previous section and reference should be made thereto for an understanding of the time period that the resin columns had been operating prior to the sampling period.

FIGURE 2
ELUTION PROCESS

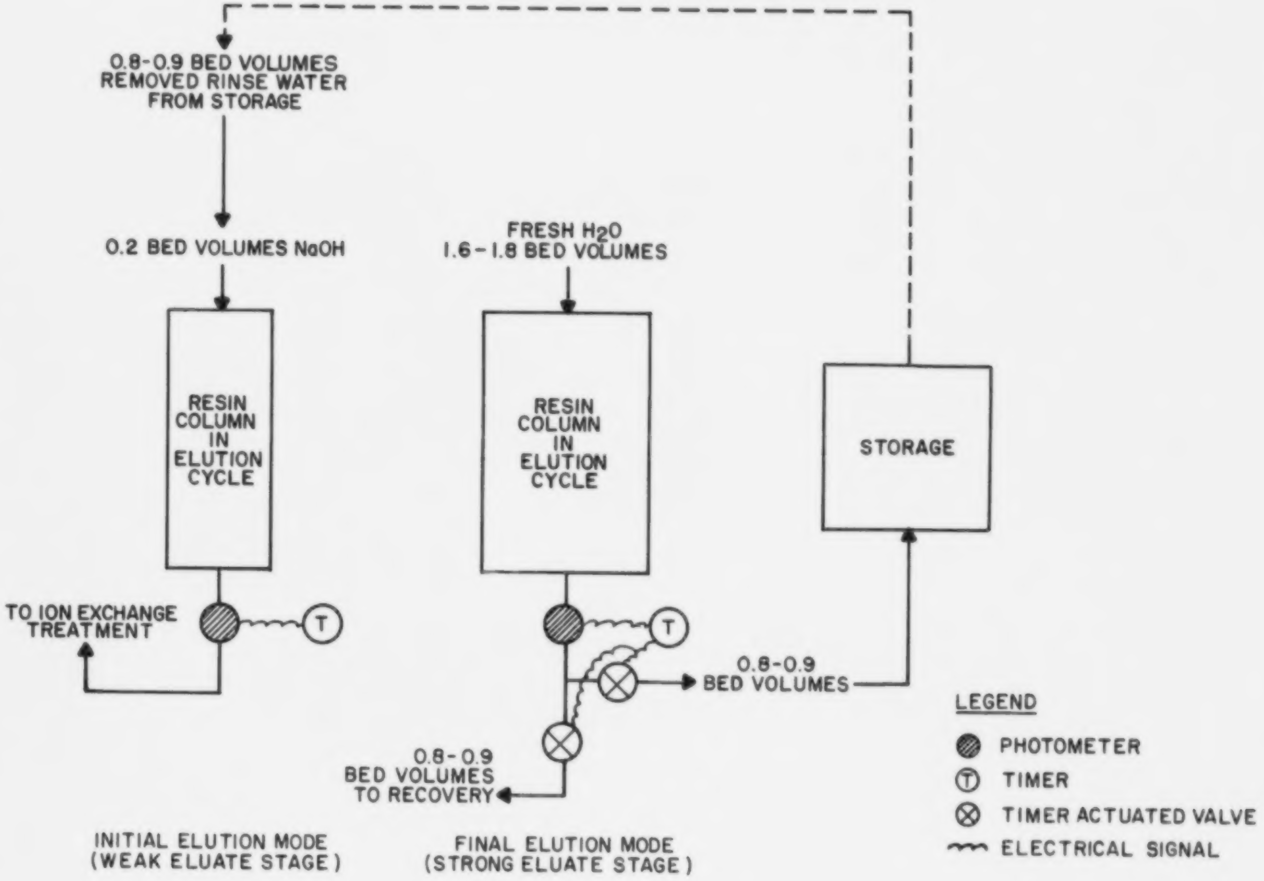

0.8-0.9 BED VOLUMES REMOVED RINSE WATER FROM STORAGE
0.2 BED VOLUMES NaOH
FRESH H_2O 1.6 – 1.8 BED VOLUMES
RESIN COLUMN IN ELUTION CYCLE
RESIN COLUMN IN ELUTION CYCLE
STORAGE
TO ION EXCHANGE TREATMENT
T
T
0.8-0.9 BED VOLUMES
0.8-0.9 BED VOLUMES TO RECOVERY
INITIAL ELUTION MODE (WEAK ELUATE STAGE)
FINAL ELUTION MODE (STRONG ELUATE STAGE)
LEGEND
PHOTOMETER
TIMER
TIMER ACTUATED VALVE
ELECTRICAL SIGNAL

FIGURE 3
BATCH PLANT ELUTION PROCESS

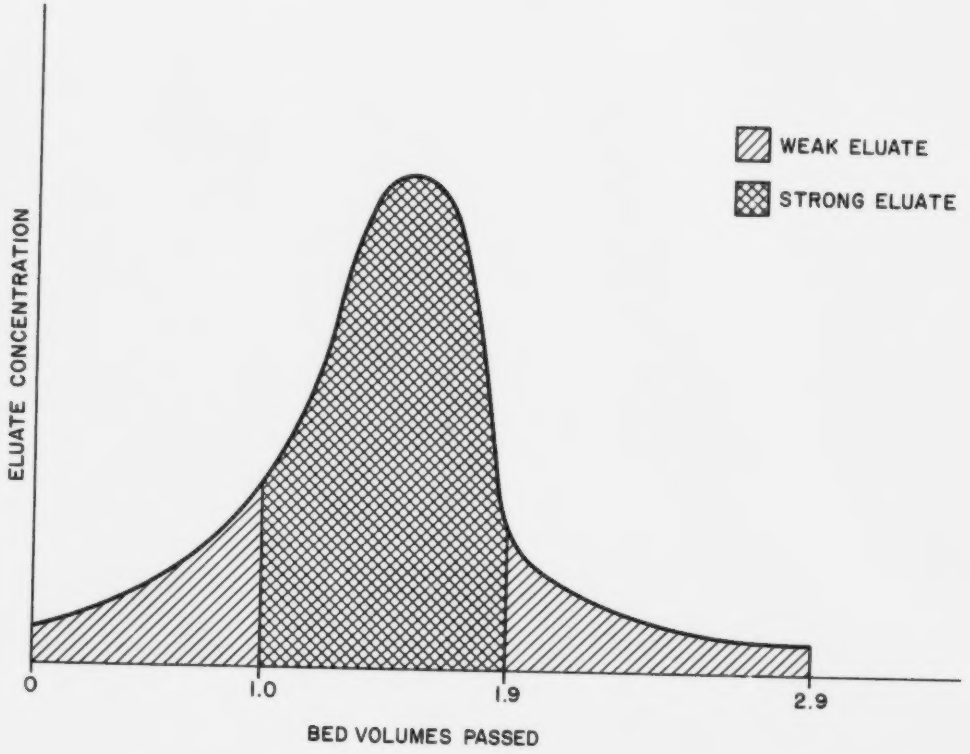
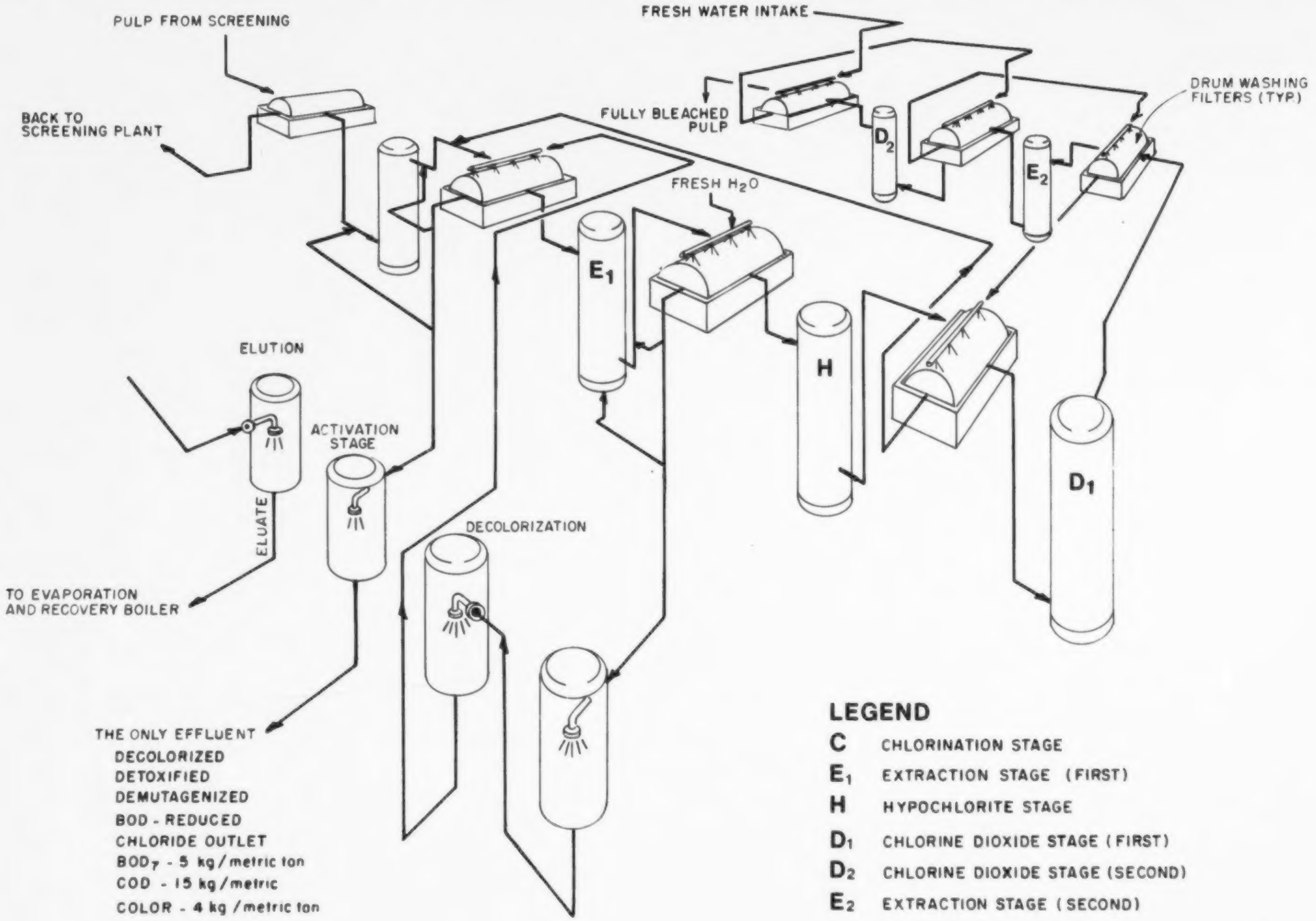


FIGURE 4
THE BILLERUD NON-POLLUTING BLEACH PLANT CONCEPT


PULP FROM SCREENING
BACK TO SCREENING PLANT
FRESH WATER INTAKE
FULLY BLEACHED PULP
DRUM WASHING FILTERS (TYP.)
D_2
E_2
FRESH H_2O
E_1
H
D_1
ELUTION
ACTIVATION STAGE
ELUATE
DECOLORIZATION
TO EVAPORATION AND RECOVERY BOILER
THE ONLY EFFLUENT
DECOLORIZED
DETOXIFIED
DEMUTAGENIZED
BOD - REDUCED
CHLORIDE OUTLET
BOD_7 - 5 kg/metric ton
COD - 15 kg/metric
COLOR - 4 kg/metric ton
LEGEND
C CHLORINATION STAGE
E_1 EXTRACTION STAGE (FIRST)
H HYPOCHLORITE STAGE
D_1 CHLORINE DIOXIDE STAGE (FIRST)
D_2 CHLORINE DIOXIDE STAGE (SECOND)
E_2 EXTRACTION STAGE (SECOND)

The purpose of this sampling program was to supply a portion of the information necessary to perform the technical assessment phase of this project. This information will aid in determining: 1) the removal efficiency of the columns as measured by color, COD, metals and toxic pollutants; and 2) the decrease in removal efficiency during the three hour operation cycle. Table 11 outlines the sample types taken for detailed analysis.

Program Number 2

On Tuesday, March 4, 1980, the full-scale ion exchange batch plant was sampled again, this time for nine-hours. This period represents three cycles of operation, i.e., each column performed each function (primary column, secondary column, regeneration/reactivation).

Figure 5 presents the operational mode of the resin beds on March 4, 1980. Samples were collected from the influent to the first column, the influent to the second column, and the effluent from the second column. These samples were obtained every 30 minutes from 0915 to 1745 for the semi-volatile organics and metals analyses. Two 50 ml aliquots were drawn from each sampling point at the start of each 30 minute period. One of the aliquots was added to a composite sample for semi-volatile organics analysis; the other was added to a metals composite.

Duplicate volatile organic samples were obtained at 1148 and at 1248. These times represent a one-hour bed run and a two-hour bed run, respectively.

At the completion of this sampling program, three composite samples had been collected for the semi-volatile organics analysis, three for the metals analysis, and four samples (two sets of duplicates) for the volatile organics analysis. In addition, the batch plant's flow, pressure, pH, temperature, color, and COD were measured during each 30 minute period.

Results and Discussion

The analysis results for sampling programs 1 and 2 are presented in Tables 12 through 18. The efficiencies for the compounds removed by ion exchange treatment are presented graphically in Figures 6 through 16. Program 1 was organized to determine the change in pollutant removal through operations cycles, while program 2 was designed to determine the overall average removal through a cycle of operation.

Figures 6 and 7 (color and COD removal) show that the first ion exchange column removes a constant portion of the load after about half of the sample time. Column 2, on the other hand, consistently decreases in removal efficiency throughout the cycle. This phenomenon occurred for the color, COD and the metals which were removed. One explanation is that some organics in the wastewater have more strongly ionized molecular groups that will be tightly bound to the active sites of the exchanger. Other organics in the wastestream that contain weakly ionic groups are attracted to the resin,

TABLE 11. SAMPLING PROGRAM NUMBER 1
SAMPLES TAKEN

Location	Sample type	Sampling time	Remarks
First column influent	Semi-volatile Organics	1015	1 liter container was utilized with one third of the volume collected each hour (1015, 1115 and 1215).
		1115	
		1215	
	Metals	1015	1 liter container was utilized with one third of the volume collected each hour (1015, 1115 and 1215).
		1115	
		1215	
	Volatile Organics	1015	Two volatile organics bottles were filled each hour (1015, 1115 and 1215).
		1115	
		1215	
Second column influent (last column in series)	Semi-volatile Organics	1015	1 liter sample taken
		1115	1 liter sample taken
		1215	1 liter sample taken
	Metals	1015	1 liter sample taken
		1115	1 liter sample taken
		1215	1 liter sample taken
	Volatile Organics	1015	Two volatile organics bottles were filled each hour.
		1215	
		1215	
Second column effluent (treated effluent)	Semi-volatile Organics	1015	1 liter sample taken
		1115	1 liter sample taken
		1215	
	Metals	1015	1 liter sample taken
		1115	1 liter sample taken
		1215	1 liter sample taken
	Volatile Organics	1015	Two volatile organics bottles were filled each hour.
		1115	
		1215	

FIGURE 5
ION-EXCHANGE BATCH PLANT OPERATION
MARCH. 4, 1980
PROGRAM #2

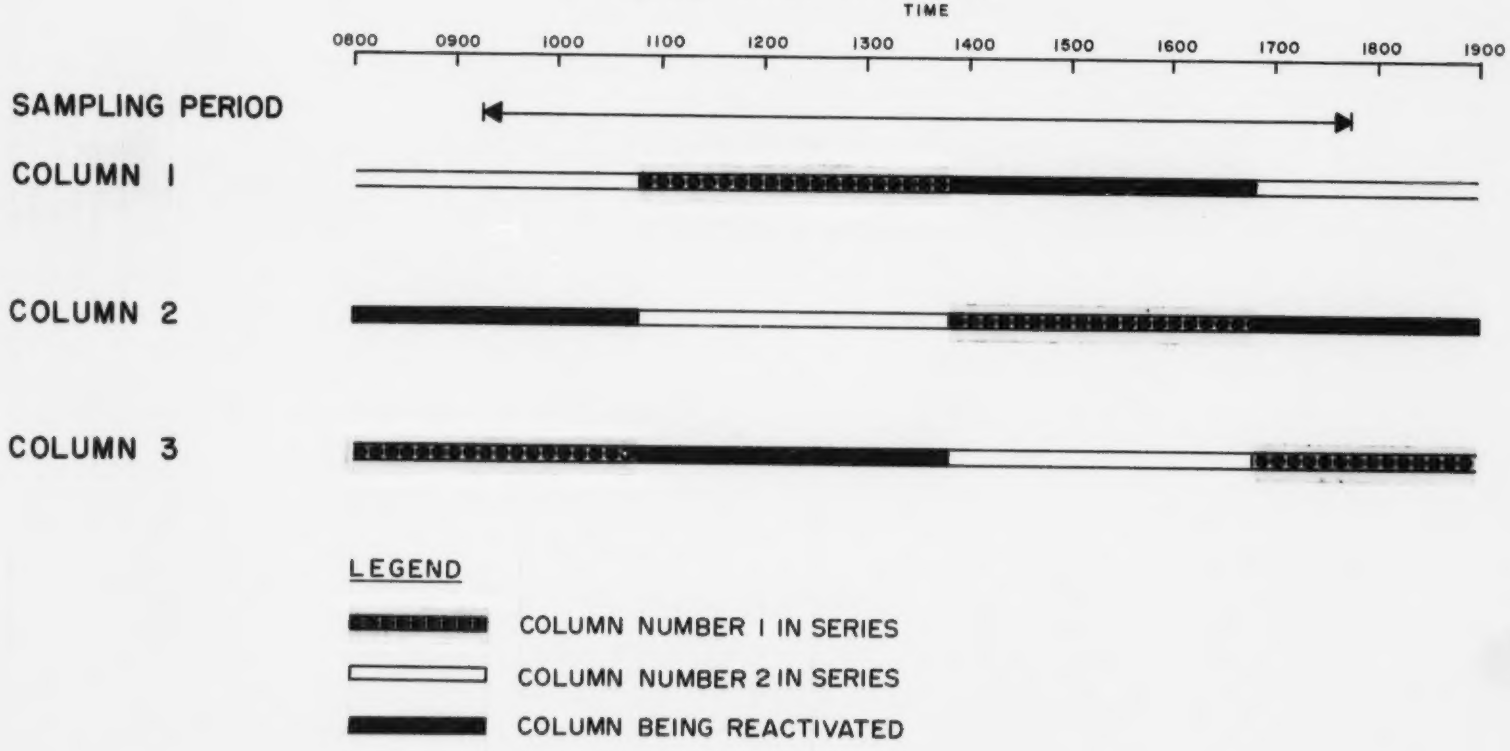


TABLE 12. BATCH PLANT ION-EXCHANGE SYSTEM FLOW AND PRESSURE LEVELS
Program Number 2

Sample time	Operating mode	Flow m^3/hr	Resin bed influent pressure kg/cm^2	Resin bed effluent pressure kg/cm^2
0915	Column 1	71	4.65	3.68
	Column 2	70	3.65	*
0945	Column 1	70	4.65	3.68
	Column 2	70	3.70	*
1015	Column 1	71	4.65	3.65
	Column 2	71	3.70	*
1045	Column 1	71	4.65	3.65
	Column 2	71	3.70	*
1048	Resin Bed Operation Functions Changed			
1115	Column 1	79	3.80	*
	Column 2	73	3.40	3.30
1145	Column 1	74	4.90	*
	Column 2	73	3.55	3.35
1215	Column 1	73	4.90	*
	Column 2	72	3.60	3.35
1245	Column 1	73	4.90	*
	Column 2	73	3.65	3.35
1325	Column 1	73	4.95	*
	Column 2	73	3.65	3.35
1345	Column 1	73	4.95	*
	Column 2	73	3.65	3.35
1348	Resin Bed Operation Functions Changed			
1415	Column 1	80	4.70	3.40
	Column 2	72	2.90	1.45
1455	Column 1	74	4.75	3.40
	Column 2	72	3.20	1.60
1515	Column 1	73	4.80	3.40
	Column 2	72	3.20	1.65

TABLE 12 - continued

Sample time	Operating mode	Flow m^3/hr	Resin bed influent pressure kg/cm^2	Resin bed effluent pressure kg/cm^2
1545	Column 1	73	4.80	3.40
	Column 2	72	3.20	1.80
1615	Column 1	73	4.85	3.45
	Column 2	72	3.20	1.90
1645	Column 1	73	4.85	3.45
	Column 2	72	3.20	2.00
1648	Resin Bed Operation Functions Changed			
1715	Column 1	82	4.40	2.35
	Column 2	70	3.10	*
1745	Column 1	72	4.60	3.10
	Column 2	70	3.60	*

*Pressure gage not functioning

TABLE 13. COLOR, COD, CHLORIDES, pH, TEMPERATURE

	Color (color units)	COD (mg/l)	Cl- (mg/l)	pH pH	Composite temperature (°C)
2/26/80 (Program 1)					
Influent Composite	14100	3500	1500	3.4	NS
Column 2 Influent, 10:15	5910	1900	1300	4.7	NS
Effluent, 10:15	1350	640	1000	6.7	NS
Column 2 Influent, 11:15	8000	2400	1300	4.2	NS
Effluent, 11:15	3560	1300	1300	6.8	NS
Column 2 Influent, 12:15	8240	2400	1500	3.8	NS
Effluent, 12:15	4720	1600	1400	6.6	NS
3/4/80 (Program 2)					
Influent	12600	4600	1500	3.4	18.0
Column 2 Influent	6590	1600	1400	4.6	18.5
Effluent	3940	1600	1300	6.2	17.5

Note: NS - Not Sampled

TABLE 14

Volatile Organics, µg/l

	Methylene Chloride	Trichlorofluoromethane	1,1-Dichloroethane	Chloroform*	1,2-Dichloroethane	1,1,1-Trichloroethane	Bromodichloromethane	Trichloroethylene	Dibromochloromethane	Benzene	1,1,2,2-Tetrachloroethane	Tetrachloroethylene	Toluene	Chlorobenzene	Ethylbenzene
2/26/80 (Program 1)															
Influent Composite	<1	ND	ND	5500	ND	ND	13	2.8	ND	2.6	ND	2.8	3.4	ND	ND
Column 2 Influent, 10:15	<1	ND	ND	3400	ND	ND	5.7	4.6	ND	3.5	ND	2.6	3.2	ND	ND
Effluent, 10:15	<1	ND	ND	1700	ND	ND	2.5	4.6	ND	3.1	ND	1.7	4.5	ND	ND
Column 2 Influent, 11:15	<1	ND	ND	4500	ND	ND	6.5	4.3	ND	2.9	ND	2.7	5.4	1.8	ND
Effluent, 11:15	1.8	ND	ND	3800	ND	ND	3.8	8.9	ND	3.8	ND	3.3	1.8	ND	ND
Column 2 Influent, 12:15	1.2	ND	ND	8900	ND	ND	14	4.3	ND	2.3	ND	3.7	5.8	ND	ND
Effluent, 12:15	2.5	ND	ND	5300	ND	ND	7.2	5.5	ND	3.0	ND	2.3	5.8	ND	ND
3/4/80 (Program 2)															
Influent	ND	ND	ND	7700	ND	ND	9.9	2.9	ND	3.8	ND	2.4	4.0	ND	ND
Column 2 Influent	<1	ND	ND	8400	ND	ND	7.6	4.5	ND	3.0	ND	2.6	3.5	ND	ND
Effluent	<1	ND	ND	7000	ND	ND	4.9	5.8	ND	3.3	ND	3.2	2.2	ND	ND

Note: *Done by direct injection
ND - Not Detected

TABLE 15

Semi-Volatile Organics, μg/l

	2,4-Dichlorophenol	2,4,6-Trichlorophenol	2,3,5-Trichlorophenol	Diethylphthalate	Trichloroguaiacol	Tetrachloroguaiacol	Dibutyl phthalate	Heptadecanoic acid	Dehydroabietic acid	Heneicosanic acid (C21:0)	Chlorodehydroabietic acid (A)	Bis (2-Ethylhexyl) phthalate	Chlorodehydroabietic acid (B)	Dichlorodehydroabietic acid	Dioctylphthalate	9,10-Dichlorostearic acid
2/26/80 (Program 1)																
Influent Composite	73	160	8.4*	ND	340	150	1.8	90	69	36	14	5.1	28	9.3	ND	19
Column 2 Influent, 10:15	1.9	5.1	ND	2.1	19	7.3	1.5	1.9	22	39	12	3.1	24	8.4	ND	5.3
Effluent, 10:15	ND	1.3	ND	ND	18	16	7.0	10	7.3	40	5.4	18	12	13	ND	5.5
Column 2 Influent, 11:15	9.1	22	4.4*	ND	51	16	11	34	74	ND	29	67	61	27	ND	12
Effluent, 11:15	ND	ND	ND	ND	11	5.4	1.8	29	1.4	70	12	6.1	26	ND	ND	10
Column 2 Influent, 12;15	5.6	24	3.9*	ND	52	18	1.8	14	38	53	10	2.4	22	7.5	ND	ND
Effluent, 12:15	ND	1.5	ND	ND	12	5.2	ND	30	22	ND	18	3.2	41	23	ND	8.6
3/4/80 (Program 2)																
Influent	51	110	17*	ND	340	110	3.0	33	8.2	ND	5.3	110	13	12	ND	12
Column 2 Influent	3.6	5.4	2.2*	ND	24	6.8	2.1	24	4.2	ND	4.2	13	13	11	ND	7.1
Effluent	ND	1.2	ND	ND	11	12	1.4	26	1.1	ND	2.3	5.8	8.0	8.2	ND	8.4

Note: *Possibly another trichlorophenol isomer
ND - Not Detected

TABLE 16

METALS, µg/l

	Sb	As	Be	Cd	Cr	Cu	Pb	Ni	Se	Ag	Tl	Zn	Hg
2/26/80 (Program 1)													
Influent Composite	<3	7	<0.5	1.5	38	31	6	57	6	1.2	<2	200	0.83
Column 2 Influent, 10:15	<3	5	<0.5	1.0	23	28	3	52	<4	<0.5	<2	120	0.33
Effluent, 10:15	5	14	<0.5	1.5	32	10	2	53	12	1.8	<2	92	0.24
Column 2 Influent, 11:15	<3	6	<0.5	1.5	33	19	4	52	5	0.6	<2	150	0.42
Effluent, 11:15	<3	10	<0.5	<0.5	33	8	2	25	8	0.5	<2	85	0.52
Column 2 Influent, 12:15	<3	5	<0.5	1.3	23	16	4	99	<4	0.6	<2	150	0.24
Effluent, 12:15	<3	5	<0.5	0.8	28	19	8	86	<4	2.1	<2	59	0.39
3/4/80 (Program 2)													
Influent	<3	8	<0.5	1.2	37	38	4	22	<4	0.6	10	160	0.16
Column 2 Influent	<3	6	<0.5	0.9	32	17	2	39	<4	0.9	14	110	0.18
Effluent	4	11	<0.5	0.7	35	29	<1	37	8	0.8	9	79	0.32

TABLE 17

Batch Plant Percent Removals

Program Number 1

Compound	Column 1 10:15	Column 2 10:15	Overall 10:15	Column 1 11:15	Column 2 11:15	Overall 11:15	Column 1 12:15	Column 2 12:15	Overall 12:15
Color	58	77	90	43	56	75	42	43	67
COD	46	66	82	31	46	63	31	33	54
Mercury	60	27	71	49	*	37	71	*	37
Chloride	13	23	33	13	0	13	0	7	7
Copper	10	64	68	39	58	74	48	*	39
Lead	50	33	67	33	50	67	33	*	*
Zinc	40	23	54	25	43	58	25	61	71
2,4-Dichlorophenol	97	100	100	88	100	100	92	100	100
2,4,6-Trichlorophenol	97	75	99	86	100	100	85	94	99
Trichloroguaiacol	94	5	95	85	78	97	85	77	96
Tetrachloroguaiacol	95	*	89	89	66	96	88	71	97
Heptadecanoic acid	98	*	89	62	15	68	84	*	67
Dehydrobietic acid	68	67	89	*	98	98	45	42	68

Note: *Denotes an increase in the compounds concentration across this column.

TABLE 18

Batch Plant Percent Removals

Program Number 2

	Column 1°	Column 2°	Overall+
Color	48	40	69
COD	65	0	65
Mercury	increase noted during this program		
Chloride	7	7	13
Copper	55	increase of 41%	24
Lead	50	50	75
Zinc	31	28	51
2,4-Dichlorophenol	93	100	100
2,4,6-Trichlorophenol	95	78	99
Trichloroguaiacol	93	54	97
Tetrachloroguaiacol	94	*	89
Heptadecanaic acid	27	*	21
Dehydroabietic acid	49	74	87

*Denotes an increase in this compounds concentration across this column.

°Percent Removal =

$$\frac{\text{component concentration in column feed-component concentration in column discharge}}{100}$$

+Overall Percent Removal =

$$\frac{\text{component concentration in column \#1 feed-component concentration in column \#2 discharge}}{100}$$

FIGURE 6
BATCH PLANT REMOVALS

COLOR PROGRAM #1

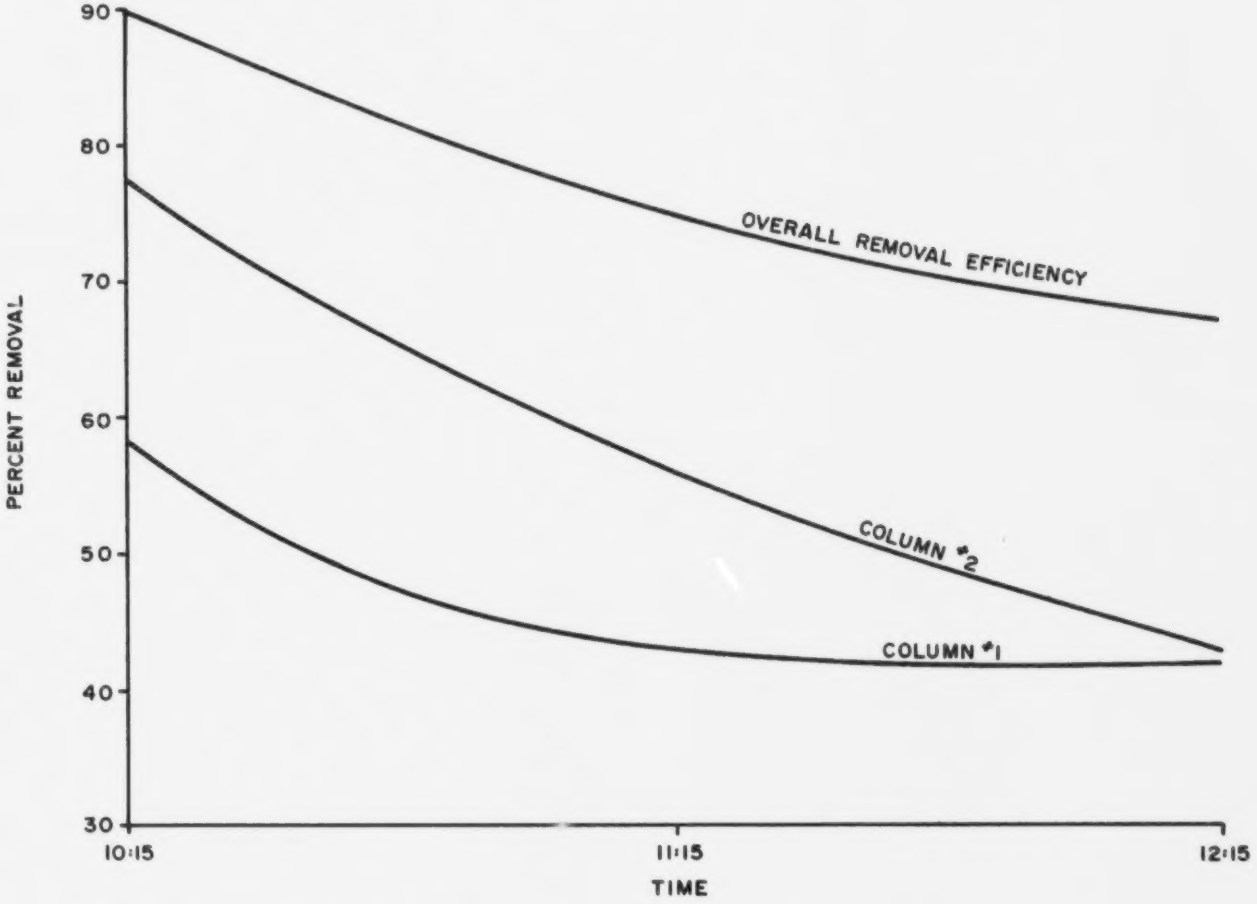


FIGURE 7
BATCH PLANT REMOVALS

COD PROGRAM #1

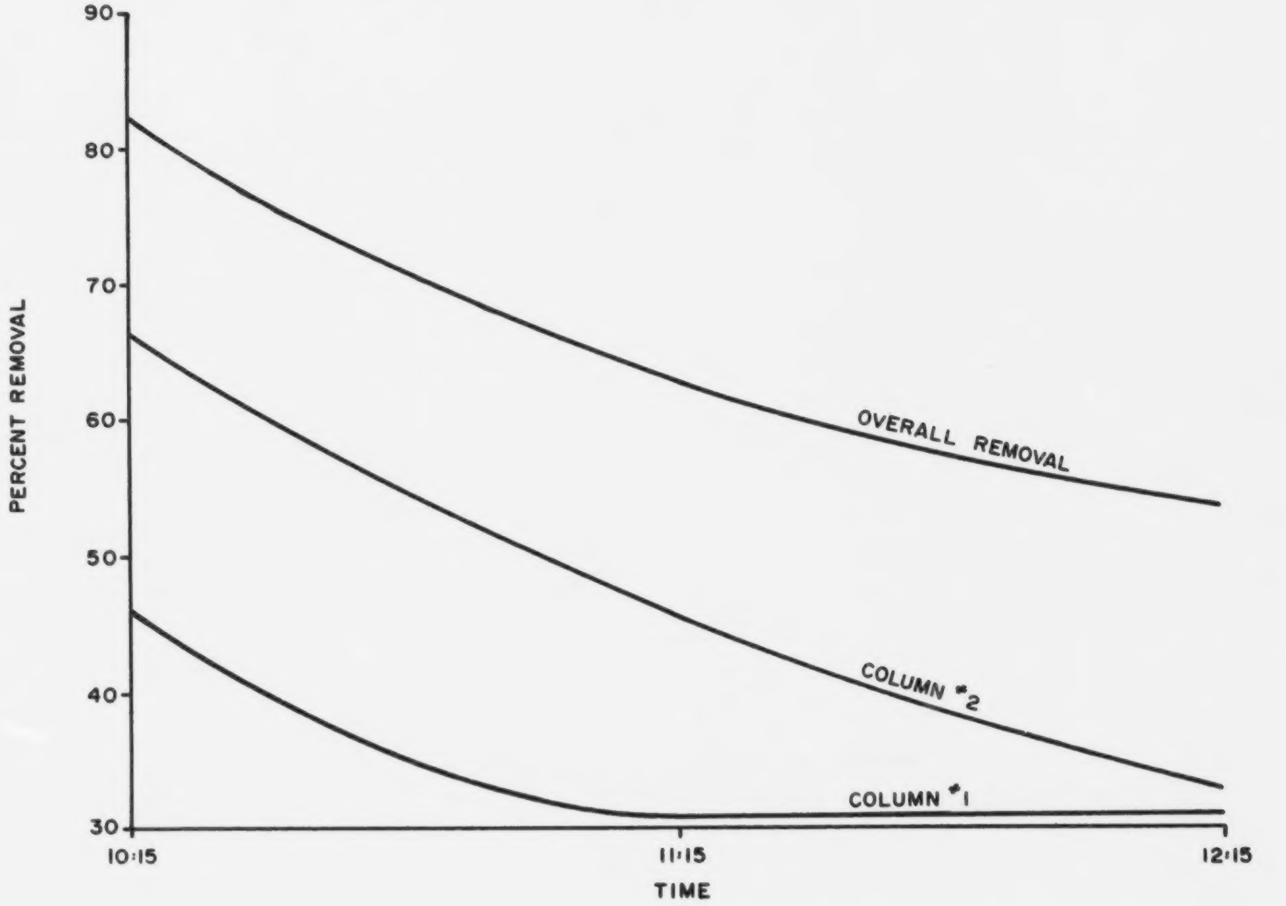


FIGURE 8
BATCH PLANT REMOVALS
CHLORIDE PROGRAM #1

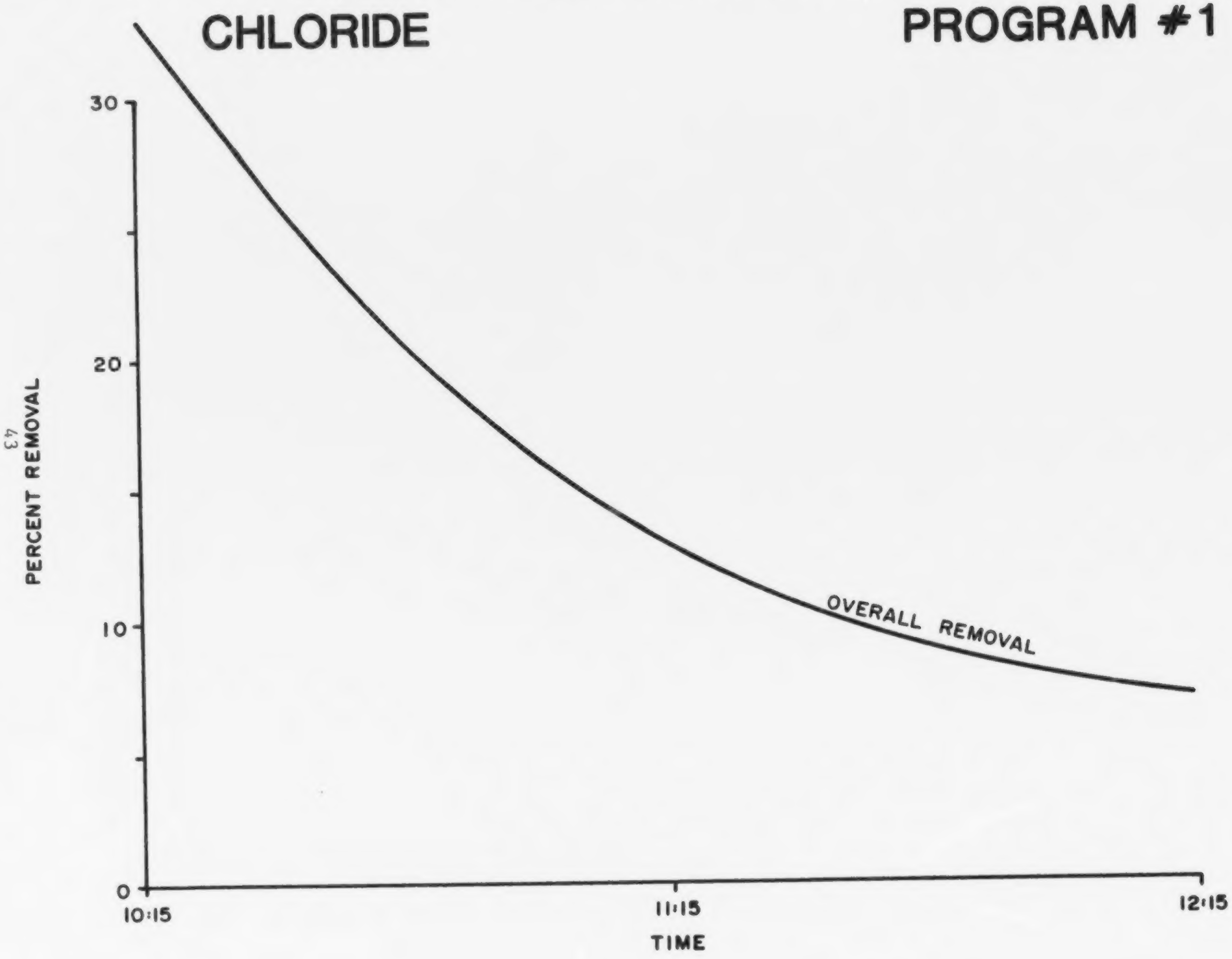


FIGURE 9
BATCH PLANT REMOVALS

MERCURY PROGRAM #1

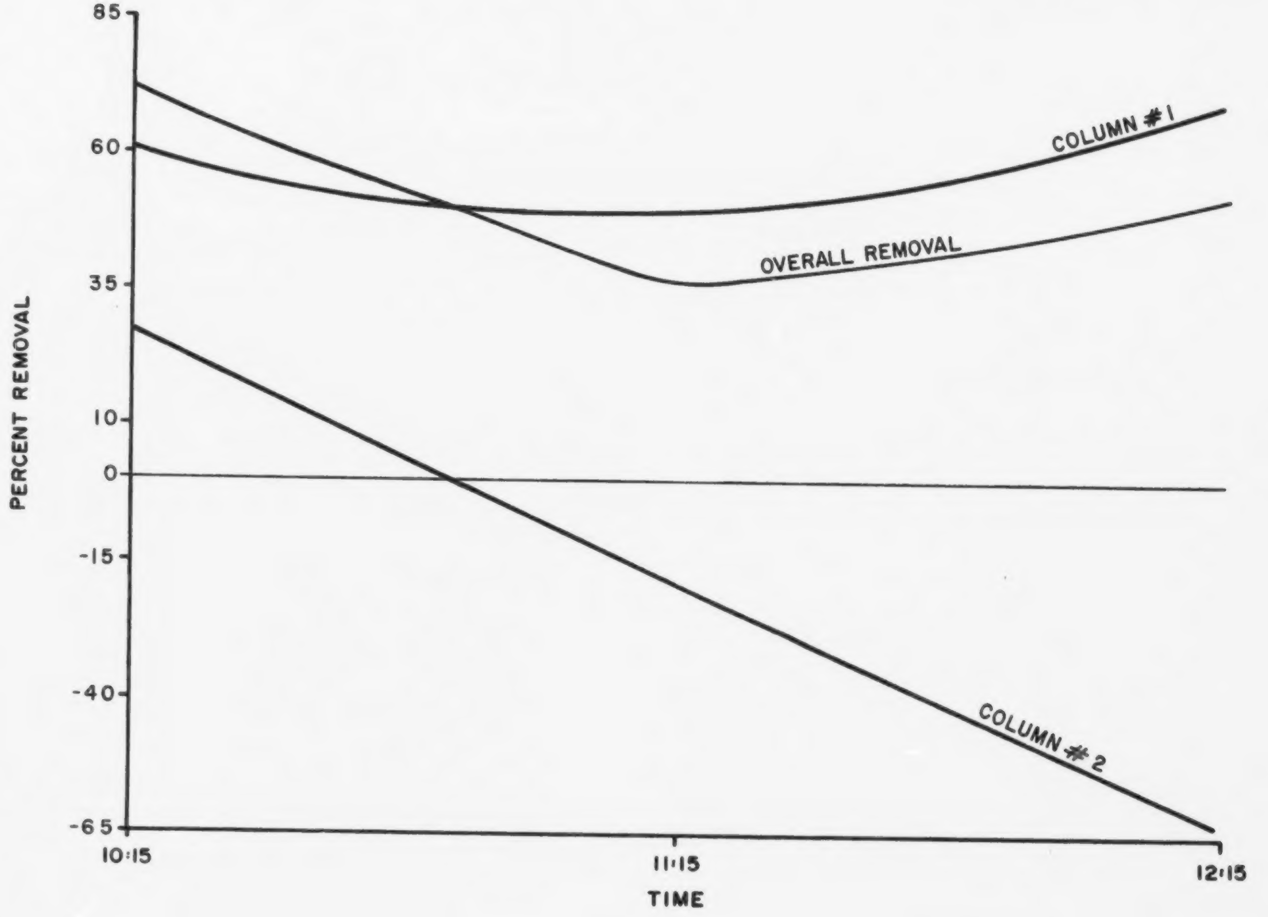


FIGURE 10
BATCH PLANT REMOVALS

COPPER PROGRAM #1

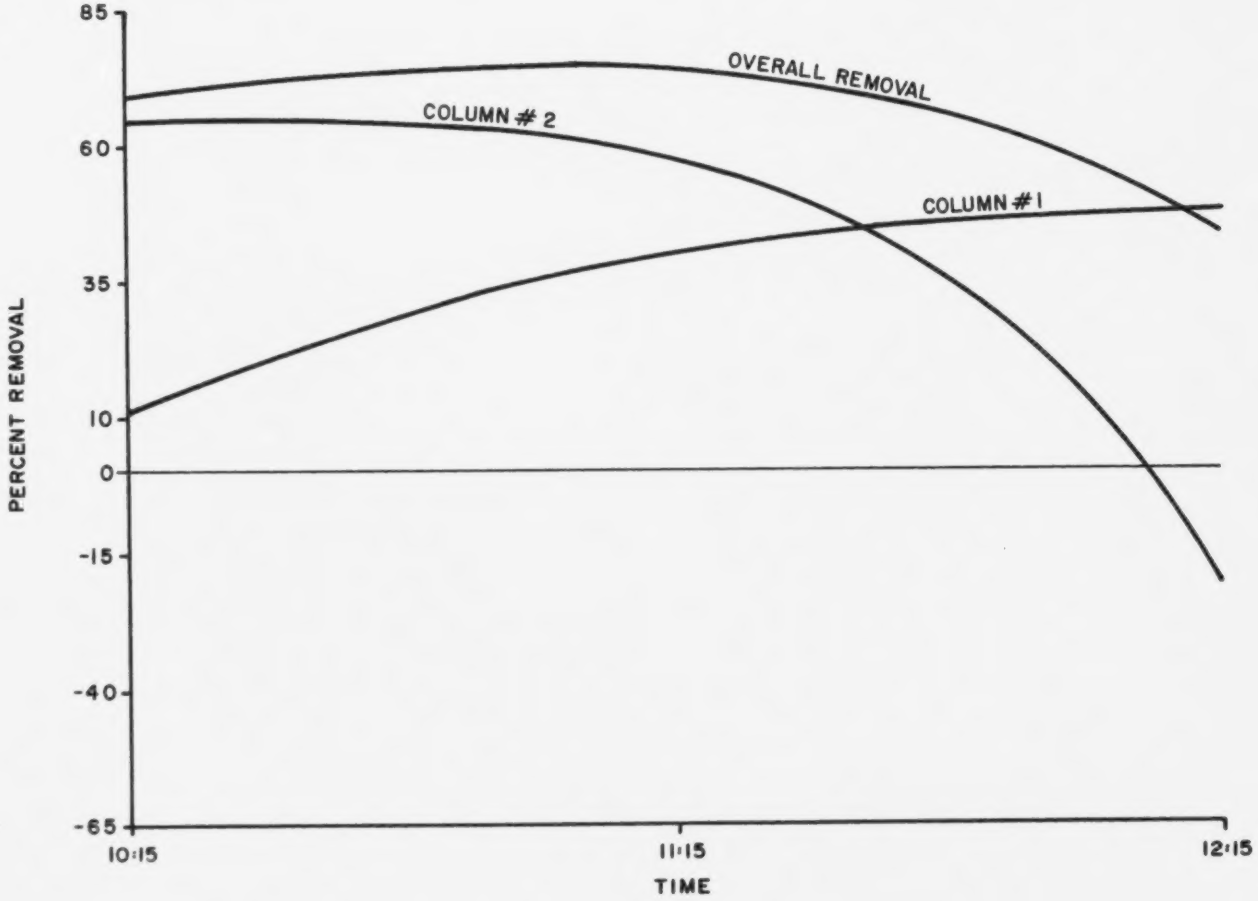


FIGURE 11
BATCH PLANT REMOVALS
2,4-DICHLOROPHENOL PROGRAM #1

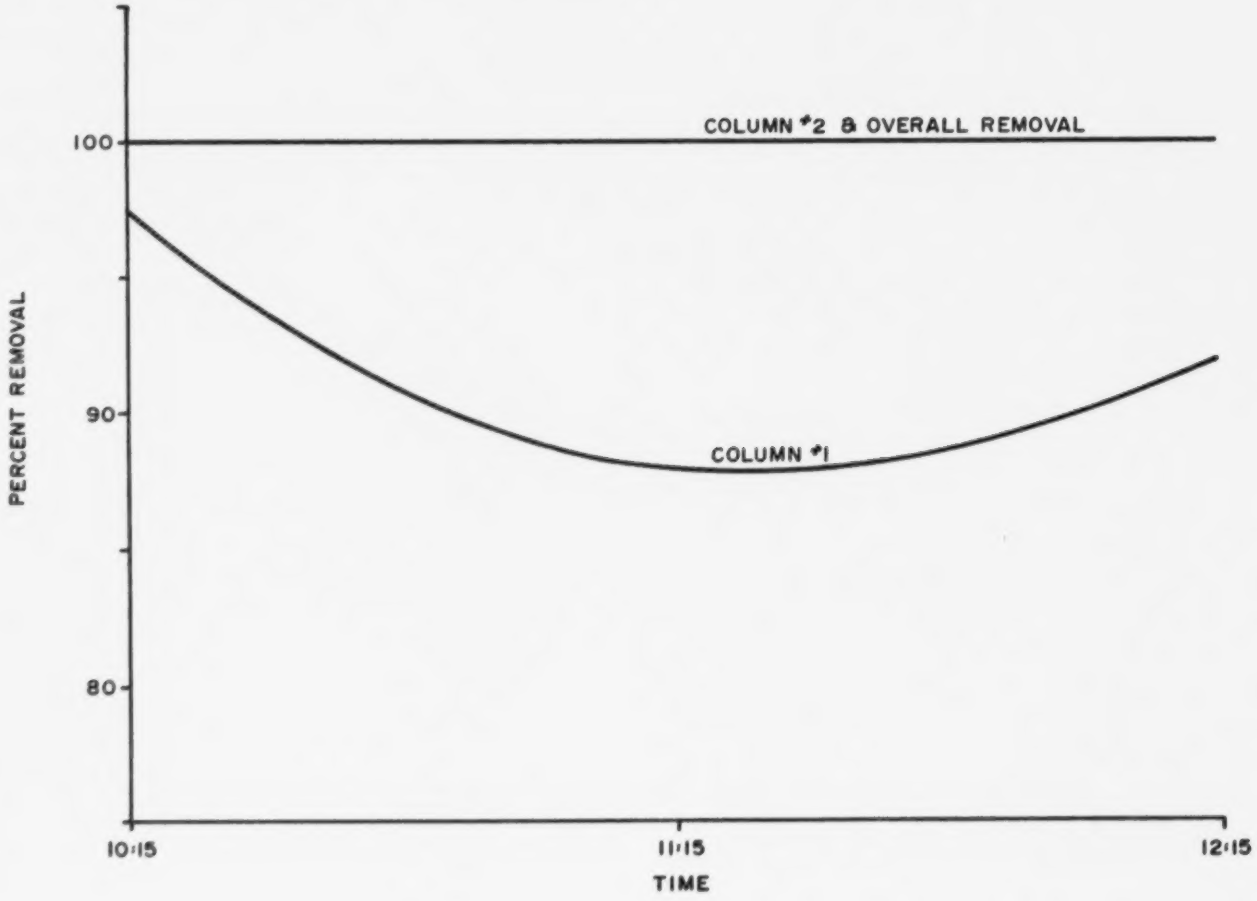


FIGURE 12
BATCH PLANT REMOVALS
2,4,6-TRICHLOROPHENOL PROGRAM #1

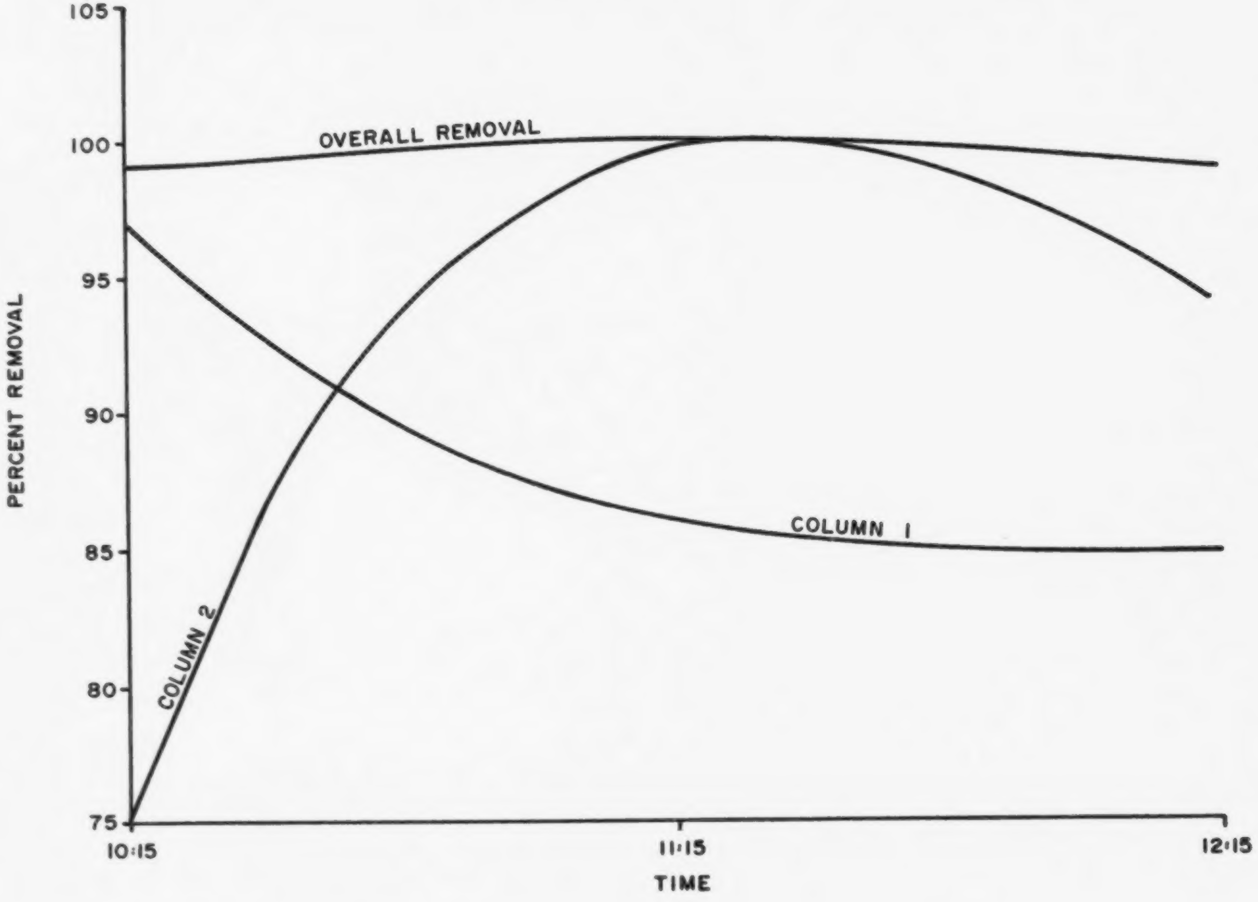


FIGURE 13
BATCH PLANT REMOVALS
TRICHLOROGUAIACOL PROGRAM #1

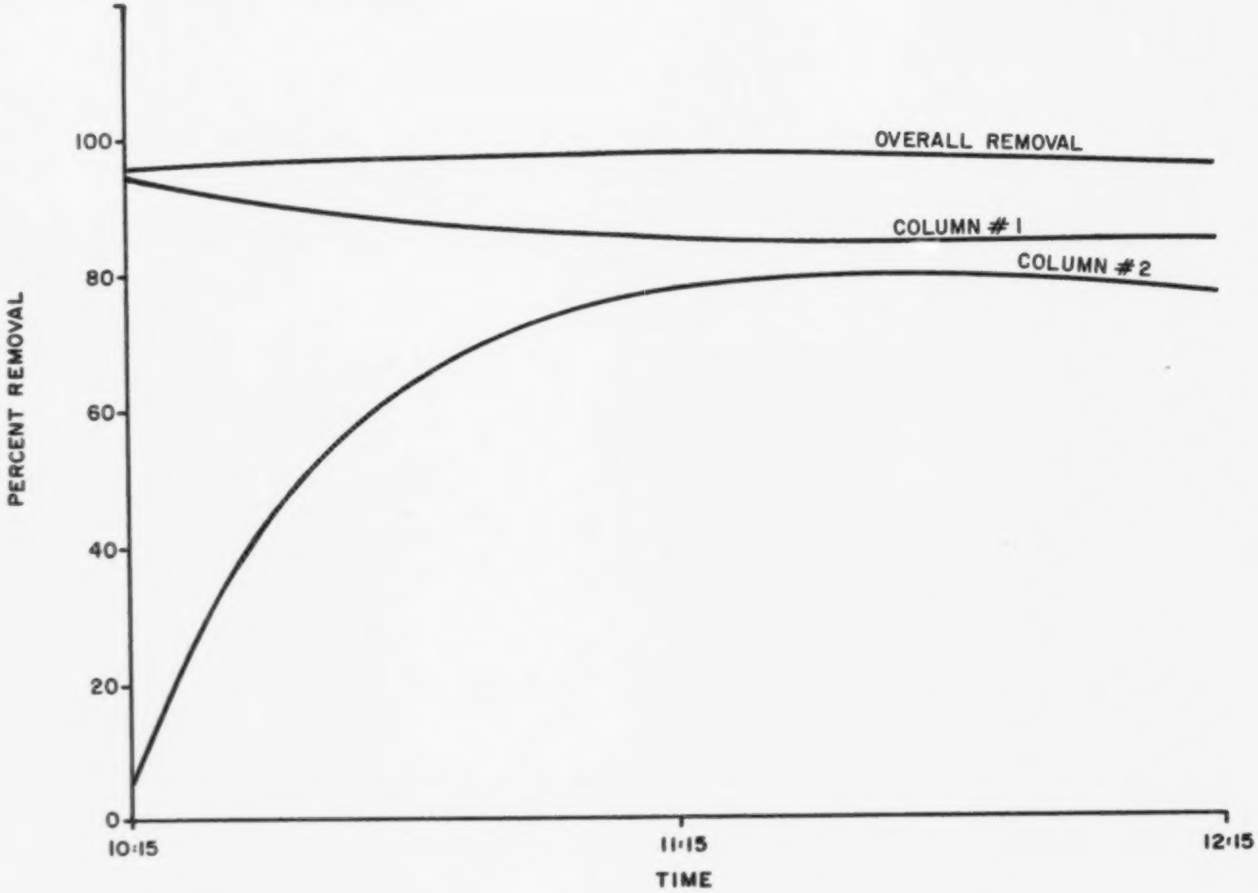


FIGURE 14
BATCH PLANT REMOVALS
TETRACHLOROGUAIACOL PROGRAM #1

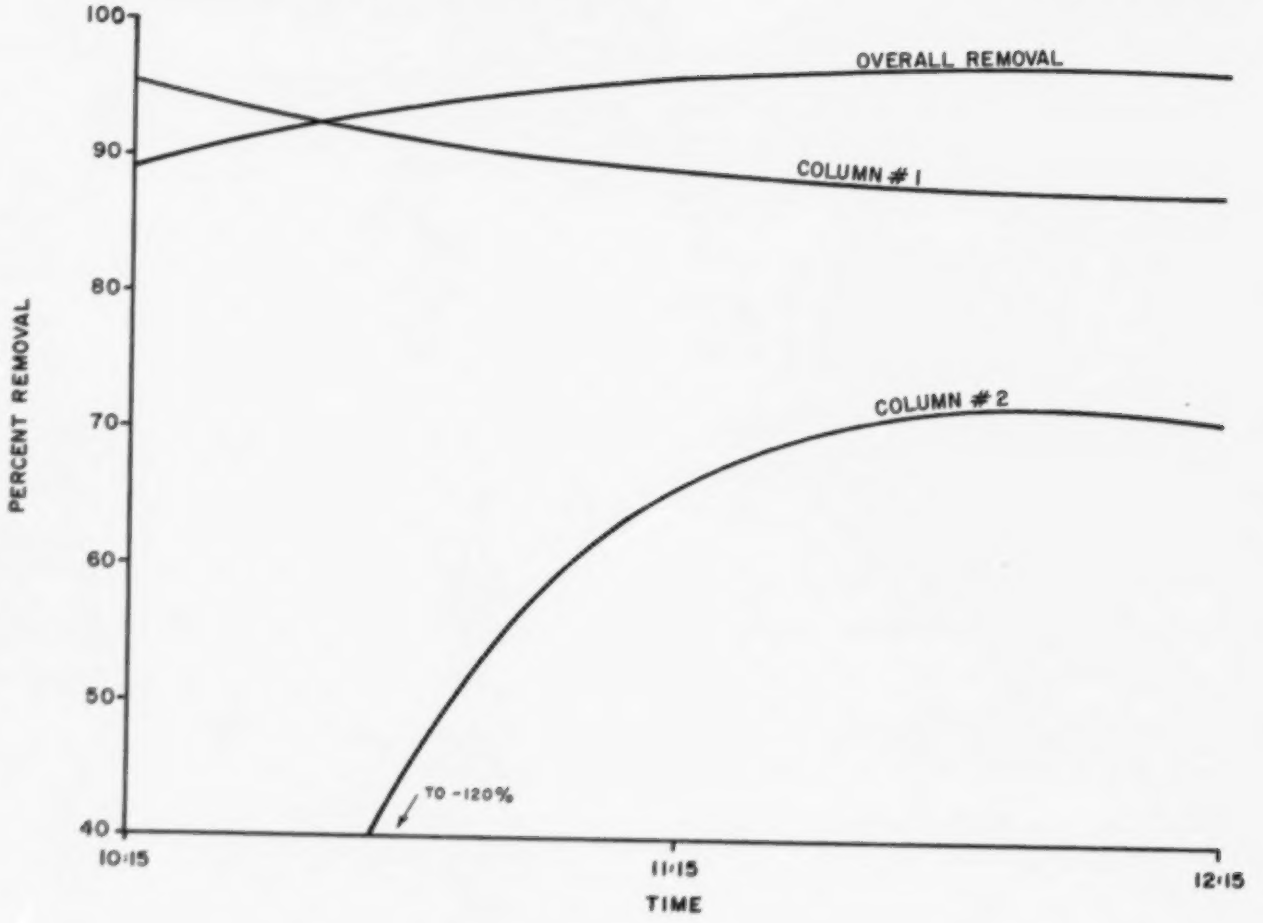


FIGURE 15
BATCH PLANT REMOVALS
HEPTADECANOIC ACID PROGRAM #1

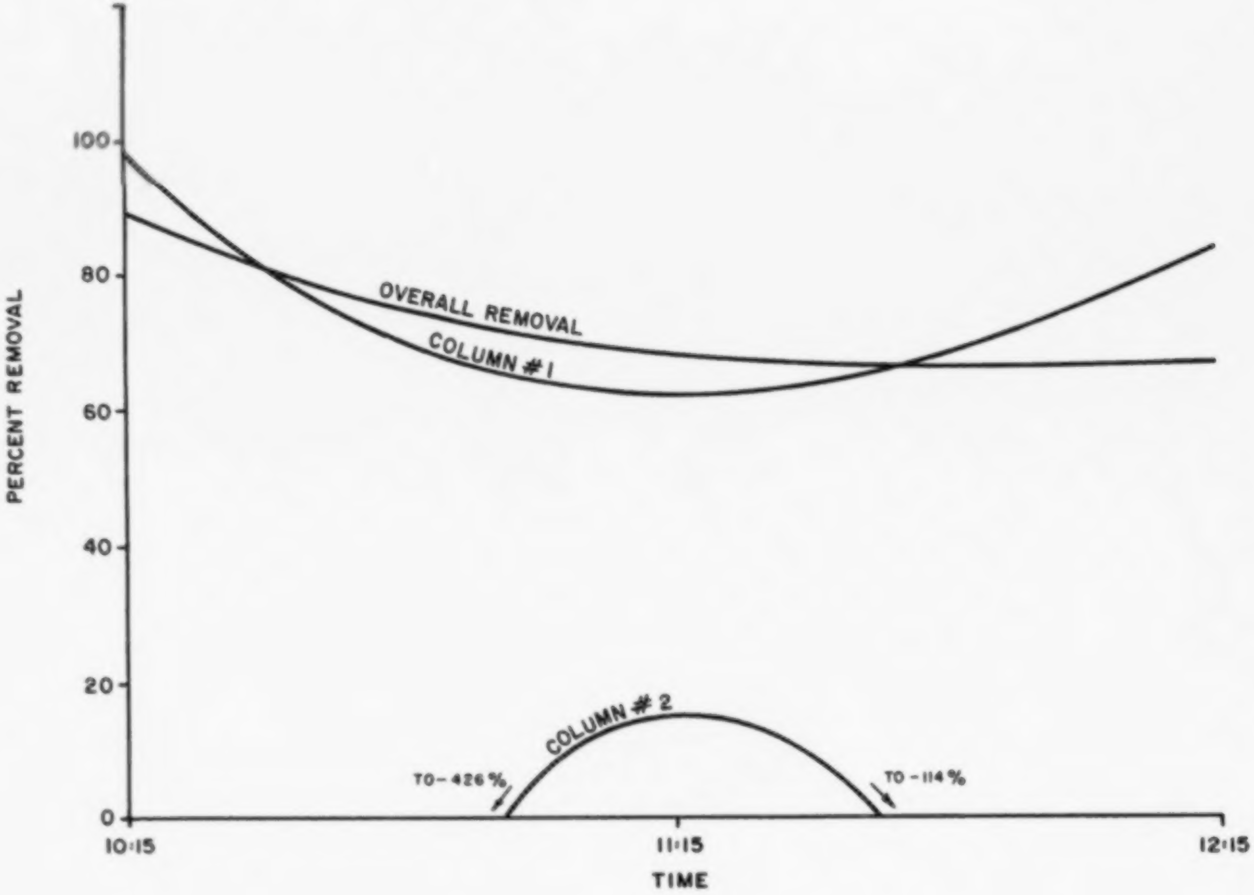
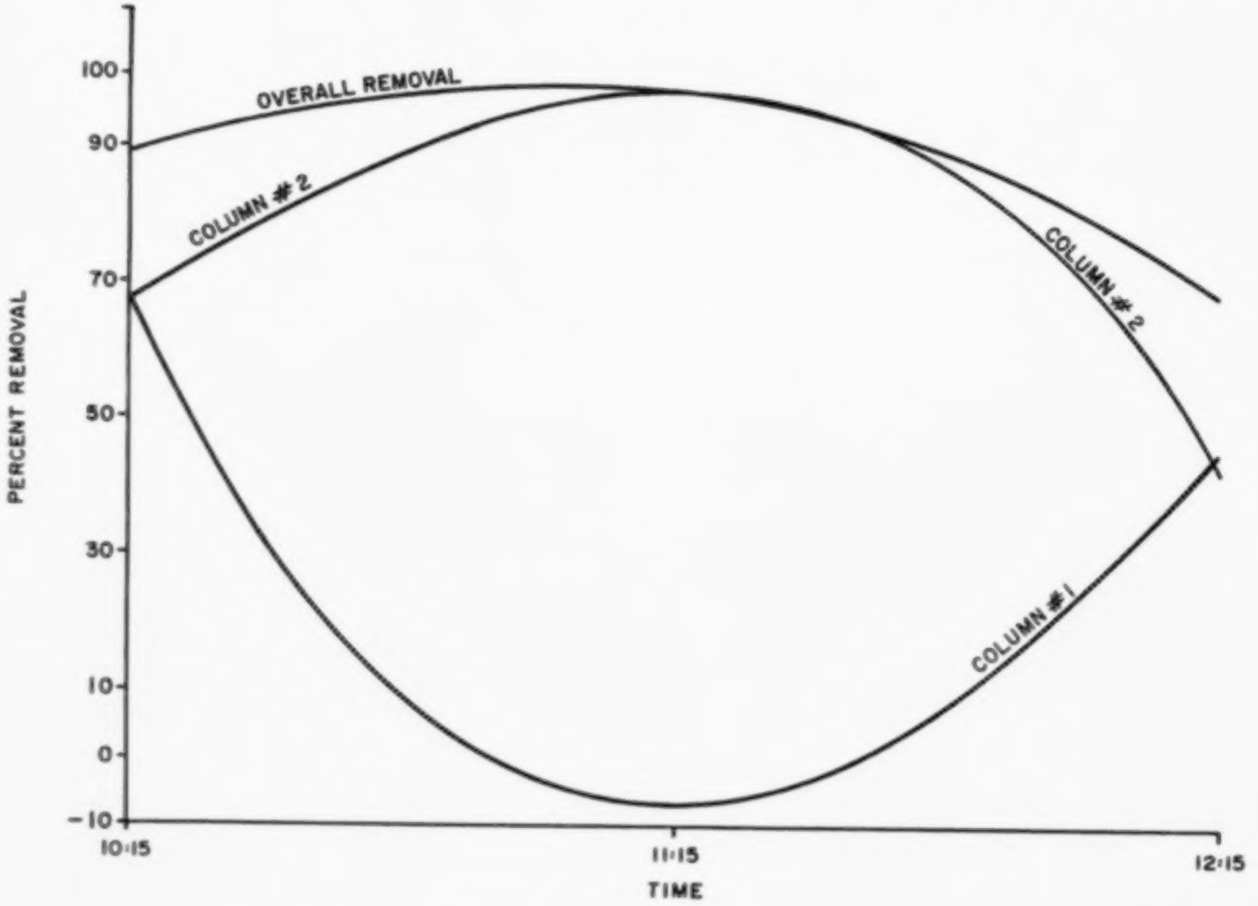


FIGURE 16
BATCH PLANT REMOVALS
DEHYDROABIETIC ACID PROGRAM #1



but the resin is less selective toward these so they are readily replaced (or eluted) by the former. In all likelihood, then column 1 binds compounds with high charge densities and alows the majority of the less charged species to pass on to the second column. The second column rapidly equilibrates with weakly bound compounds, and has a lower removal efficiency.

Three mechanisms are available to remove organic compounds from wastestreams using polymeric resins: 1) ion exchange; 2) adsorption with the polymer matrix; and 3) ion exclusion (diffusion into the pores of the matrix). The mechanisms involved in removing a particular pollutant depend, of course, on the nature of the compound and the composition of the polymeric resin. As an example, consider humic acid which can be removed by ion exchange using a strong base anion exchanger, provided the pH is sufficiently high to ionize the humic acid. But, since the resin is aromatic and hydrophobic, (styrenedivinylbenzene) some of the hydrophobic portions of the humic acid molecule are adsorbed by the matrix of the anion exchange resin. The ion exclusion mechanism tends to separate ionized and non-ionized or weakly ionized substances when both are present in the wastewater, with the latter being removed by this mechanism.

It was not anticipated that the Billerud Non-polluting Bleach Plant Concept would remove metals from the wastestream. The observed removal is postulated to be due to either metal binding with sulfhydryl groups, amide chelation, or electrostatic attraction to negatively charged macromolecules. These macromolecules are removed by the resin and the bound metals are carried along. Potential detrimental effects exist due to this metal removal process. When the concentrated eluate is burned, the metals contained in the concentrate will remain as contaminants in the slag formed in the boiler. They will not leave the recovery furnace unless excessive particulate emissions are occurring at this location. These contaminants will stay in the cooking liquor loop and care must be exercised to ensure that they do not present a problem. Billerud Uddeholm AB personnel have noted that potassium causes them the most concern, though they have not experienced problems keeping it at an acceptable level. Potassium is not removed in the green liquor clarifier and, therefore, accumulates in the white liquor. They can maintain potassium at an equivalent to 2 percent of the sodium concentration and feel the system can handle a 10 percent concentration without problems.

Reference to Table 15 and Figures 11 through 16 shows that the concentration of certain toxic pollutants (chlorinated phenols) and other compounds (resin and fatty acids and chlorinated guaiacols) are reduced during the ion exchange treatment step. Several compounds were found at or near the detection limits of the test procedures so it cannot be said with certainty that they are being removed.

Inorganic chloride is removed initially but this removal drops to a low level in a short period of time (Table 13 and Figure 8). This is important because the chlorides removed by the ion exchange process and subsequently eluted during the reactivation operation ultimately reach the recovery system resulting in accelerated corrosion.

Tables 19 and 20 present the percent recoveries for the volatile organic and semi-volatile organic spikes. The recovery data appear reasonable and are in agreement with literature values for the analytical methods used. The data presented have not been corrected for recovery because internal standards, which are not chemically identical to the compounds under identification, cannot be used to indicate recovery. The treatment of such data is controversial and should be left to the discretion of the reader. This problem has led to the promulgation of toxic pollutant methods No. 1624 and No. 1625 (Federal Register March 1981 in preparation) utilizing the isotope dilution technique for quantitation.

Table 21 outlines the results of duplicate metals analyses, as well as the results of a certified metals analysis.

TABLE 19

Recovery of Volatile Organic Spikes

(4)

Sample Description	Percent Recovery		
	d4-1,4-Dichloromethane	d6-Benzene	d8-Toluene
Program 1 2/26/80			
Batch Plant:			
Influent Composite	102	116	108
Column 2 Influent, 10:15	112	112	106
Effluent, 10:15	114	114	110
Column 2 Influent, 11:15	110	118	114
Effluent, 11:15	96	136	110
Column 2 Influent, 12:15	106	116	116
Effluent, 12:15	120	134	136
Program 2 3/4/80			
Batch Plant:			
Influent Composite	104	114	120
Column 2 Influent	114	134	126
Effluent	92	110	116
Program 3 3/4/80			
Pilot Plant:			
Influent Composite	124	116	114
Column 2 Influent	108	132	130
Effluent	104	80	94
Activation Influent	104	82	92
Activation Effluent	NS	NS	NS
Program 4 3/5/80			
Pilot Plant:			
Influent Composite	102	106	90
Column 2 Influent	106	116	122
Effluent	100	142	140
Activation Influent	128	100	106
Activation Effluent	NS	NS	NS
Program 5 3/5/80			
Pilot Plant:			
Bed 2 Influent, 0-70, Raw Waste	90	86	100
Bed 1 Influent, 0-70	188*	162*	154
Bed 1 Effluent, 0-70	80	106	106
Activation Influent, 40-150	108	116	116

TABLE 19 (continued)

Recovery of Volatile Organic Spikes

(4)

Sample Description	Percent Recovery		
	d4-1,4-Dichloromethane	d6-Benzene	d8-Toluene
Program 5 3/5/80 (cont.)			
Activation Effluent, 35-85	86	96	92
Column 1 Influent, 80-150, Raw Waste	104	122	138
Bed 1 Influent, 80-150	96	96	92
Bed 1 Effluent, 80-150	104	100	98
Strong Eluate	92	112	106
Activation Effluent, 95-135	100	130	124
Bed 1 Influent, 160-230, Raw Waste	84	112	122
Bed 1 Effluent, 160-230	90	112	110
Bed 4 Effluent, 160-230	86	126	114
Program 6 3/6/80			
Pilot Plant:			
Influent Composite	86	94	92
Column 2 Influent	130	106	122
Column 2 Effluent	142	110	114
Column 2 Influent	132	116	122
Column 2 Effluent	128	112	118
Column 2 Influent	116	126	138
Column 2 Effluent	118	120	116
Activation Column Effluent	106	100	98
Average	106	112	112
Standard Deviation	15	14	22

Notes: NS - Not Sampled
*Value is an outlier on the basis of a T-test

TABLE 20

Recovery of Semi-Volatile Organic Spikes

(4)

Sample Description	Spike (ug)	Percent Recovery Pentafluorophenol	 d8-Naphthalene	 d8-Stearic Acid
Program 1 2/26/80				
Batch Plant:				
Influent Composite	50	56	64	4.4
Column 2 Influent, 10:15	20	34	55	ND <5
Effluent, 10:15	10	75	64	55
Column 2 Influent, 11:15	20	90	60	18
Effluent, 11:15	10	78	58	17
Column 2 Influent, 12:15	20	46	55	ND <5
Effluent, 12:15	10	51	67	20
Program 2 3/4/80				
Batch Plant:				
Influent Composite	50	44	68	7.8
Column 2 Influent	20	32	48	9.5
Effluent	10	39	58	ND <5
Program 3 3/4/80				
Pilot Plant:				
Influent Composite	50	50	46	15
Column 2 Influent	20	270*	32	18
Effluent	10	54	61	35
Activation Influent	20	50	65	70
Activation Effluent	10	40	51	91
Program 4 3/5/80				
Pilot Plant:				
Influent Composite	50	28	42	6.2
Column 2 Influent	20	29	43	12
Effluent	10	31	48	16
Activation Influent	20	36	60	60
Activation Effluent	10	26	48	76
Program 5 3/5/80				
Pilot Plant:				
Bed 2 Influent, 0-70, Raw Waste	50	36	40	ND <5
Bed 1 Influent, 0-70	20	45	45	10
Bed 1 Effluent, 0-70	10	63	42	ND <5
Activation Influent, 40-150	20	65	60	50

TABLE 20 (continued)

Recovery of Semi-Volatile Organic Spikes

(4)

Sample Description	Spike (ug)	Percent Recovery		
		Pentafluorophenol	d8-Naphthalene	d8-Stearic Acid
Program 5 3/5/80 (cont.)				
Activation Effluent, 35-85	20	65	50	48
Column 1 Influent, 80-150, Raw Waste	50	38	58	3.2
Bed 1 Influent, 80-150	50	28	56	9.2
Bed 1 Effluent, 80-150	20	75	85	ND <5
Strong Eluate	200	44	60	20
Activation Effluent, 95-135	10	54	54	72
Bed 1 Influent, 160-230, Raw Waste	50	58	50	4.4
Bed 1 Effluent, 160-230	20	28	30	12
Bed 4 Effluent, 160-230	10	38	67	39
Program 6 3/6/80				
Pilot Plant:				
Influent Composite	50	44	38	ND <5
Column 2 Influent	20	38	30	ND <5
Column 2 Effluent	10	35	32	ND <5
Column 2 Influent	20	55	40	ND <5
Column 2 Effluent	10	21	27	35
Column 2 Influent	20	15	34	7.5
Column 2 Effluent	10	77	110	ND <5
Activation Column Effluent	10	36	58	44
Average		46	53	22
Standard Deviation		17	16	25

Note: ND - Not Detected - 1/2 reported value used in average
*Value is an outlier on the basis of a T-test

TABLE 21

Metals-Duplicate And Certified Analyses

(4)

	Duplicate Analysis Concentrations in µg/l											
Description	Sb	As	Be	Cd	Cr	Cu	Pb	Ni	Se	Ag	Tl	Zn
Program 1	<3	6	<0.5	1.3	23	18	3	58	<4	0.5	<2	150
Column 2 Influent, 12:15	<3	5	<0.5	1.2	23	14	5	140	<4	0.7	<2	150
Program 5	<3	<2	<0.5	0.8	5	4	<1	<5	<4	<0.5	23	110
Bed 1 Effluent, time 0-70 min.	<3	<2	<0.5	1.5	4	4	<1	<5	<4	<0.5	12	110
Program 5	<3	<2	<0.5	1.9	10	37	2	<5	<4	<0.5	<2	550
Activation Effluent, time												
35-85 min.	<3	<2	<0.5	2.1	10	38	2	<5	<4	<0.5	<2	490
Program 6	<3	3	<0.5	0.6	24	5	<1	<5	<5	<0.5	25	110
Column 2 Effluent, 0-2 hrs.	<3	3	<0.5	0.6	25	4	<1	<5	<4	<0.5	20	110
					Certified Standards							
Radian	--	27	17	5.1	15	18	24	40	5.0	--	--	13
Certified	--	26	16	5.2	16	16	22	26	5.2	--	--	11

SECTION 7

PILOT PLANT TECHNICAL ASSESSMENT

DESCRIPTION OF THE PILOT PLANT

When the batch system was constructed at Billerud Uddeholm AB, color removal was of primary concern. However, in recent years toxicity, because of accumulation and direct biologic effects to the environment, has become of concern (6). Consequently, Billerud Uddeholm AB personnel developed the "Non-polluting Bleach Plant Concept" (Figure 4, page 29) for the reduction of toxic pollutants in bleach plant effluents. This system was an expansion of the concept for color removal. Essentially, the system seeks to close up the bleach plant in order to minimize effluent volumes and conserve energy. Only two effluents, the first caustic extraction stage and the chlorination stage, are discharged from the bleach plant and these are treated by ion exchange technology. The ion exchange resin is eluted by the addition of caustic and the resin is reactivated with chlorination stage effluent. In addition to reactivating the resin, the chlorination stage effluent is cleaned during the process.

In developing this system, Billerud Uddeholm AB personnel constructed a 70 liter/hr micro-processor controlled pilot plant in 1976. This system was constructed for approximately 250,000-300,000 Swedish Kronor ($60,000-$75,000). Since initial construction the system has been modified. The pilot plant consists of the following columns:

1. first caustic extraction stage cleaning (primary column)
2. first caustic extraction stage cleaning (secondary column)
3. elution
4. chlorination stage cleaning/activation
5. backwash

The system consists of four resin beds, each of approximately 7.0 liters. The pilot plant is operated as described below.

After screening and filtration the first caustic extraction stage effluent is pumped to the first column. The wastewater flows through two resin columns placed in a series. The resin stays in this position for approximately two hours then "the secondary column" is brought into the "primary column" position and the old resin bed is transported to elution and reactivation. A newly activated resin is then brought into the "back up" position. Operating in this manner, the "dirtiest" resin is always in contact with the most concentrated wastewater stream. A resin column acts as back up for 2 hours and then as lead for 2 hours and is in contact with the first caustic extraction stage effluent for a total of four hours.

After cleaning the first caustic extraction stage effluent, the resin is transported to the elution column and caustic is added. The elution process lasts for approximately half an hour. At the current time, a small excess of caustic is added, studies have been conducted in pilot scale to optimize the caustic requirements. During elution one can observe a "plug" of color moving through the resin bed.

After elution, the resin bed is moved into the cleaning or reactivation step. The chlorination stage effluent (an acidic stream) is used to reactivate the resin. During the reactivation process, pollutants including chlorinated phenolics are reduced. The reactivation process lasts approximately 1½-2 hours. During this time there is a noticeable change in the color of the resin from a dark brown to a light brown.

The resin is moved into the backwash column after reactivation. It is backwashed for approximately 1-1½ hours, and then moved into the second column cleaning position. The effluent is discharged to the sewer while the resin beds are being transported.

The pilot plant system exhibited promising results and, after solving problems with transporting the resin between columns in the full-scale plant, Billerud Uddeholm AB personnel designed a full-scale continuous system.

Program Number 3

On Tuesday, March 4, 1980, the pilot plant was sampled and monitored through one complete cycle of the resin beds. Figure 17 describes the operating modes of the four resin beds over the period of the sampling program. For the purpose of describing the pilot plant operation throughout the day the resin beds were numbered from left to right as follows:

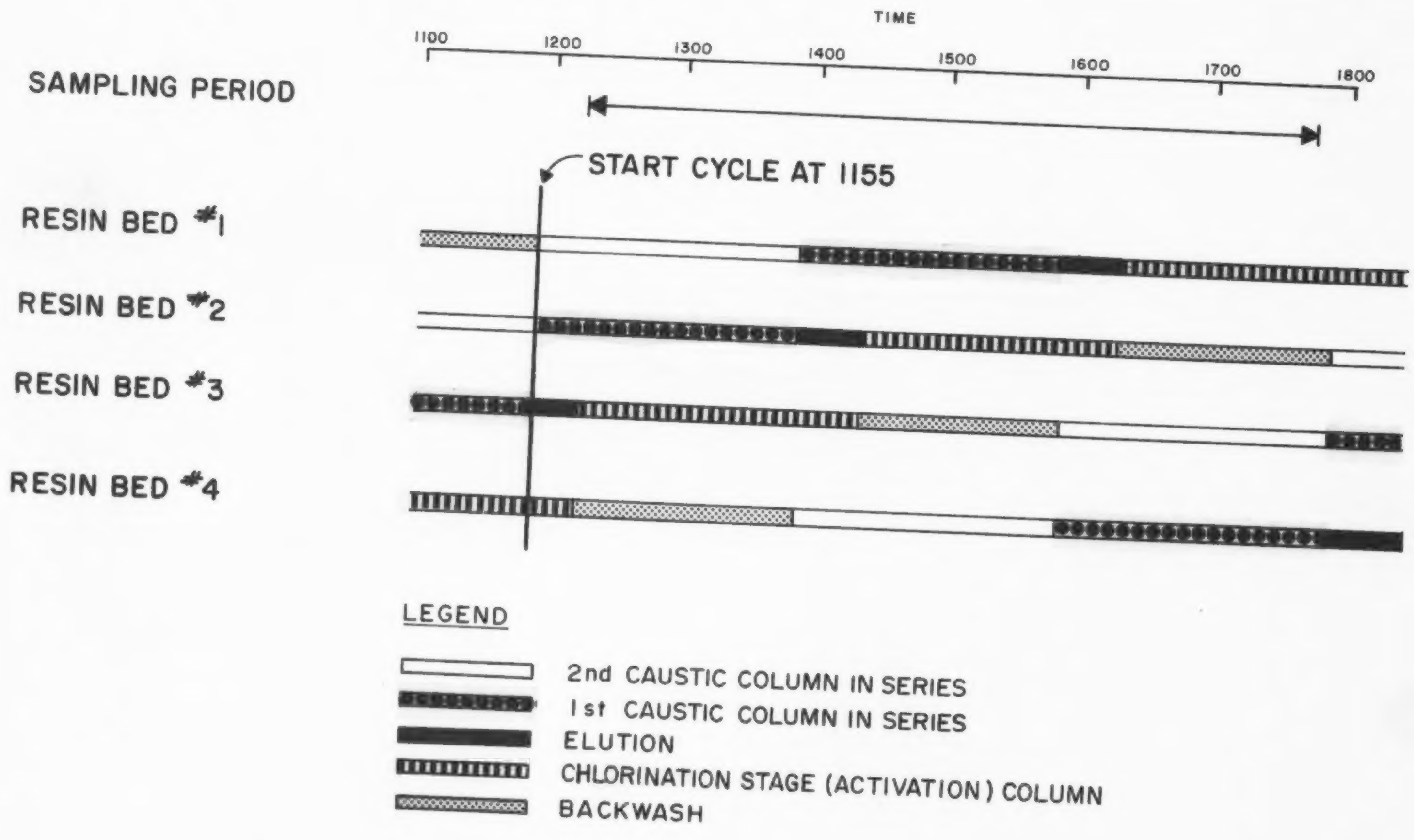
1. First Caustic Extraction Column #1
2. First Caustic Extraction Column #2
3. Elution Column
4. Chlorination Stage (activation) Column
5. Backwash Column

During this sampling program composite samples for metals and semivolatile organics were collected at the following locations:

a. Influent to the first caustic extraction column
b. Influent to the second caustic extraction column
c. Effluent from the second caustic extraction column

FIGURE 17
PILOT PLANT ION EXCHANGE OPERATION
MARCH 4, 1980

PROGRAM #3



d. Influent to the Chlorination Stage (activation) column
e. Effluent from the Chlorination Stage (activation) column

As the samples were taken every 30 minutes, the influent and effluent pH, temperature and pressure were monitored (see Table 22).

Additional samples were obtained at 1405, 1454, and 1550 at each of the five sample locations for volatile organics analysis. This procedure was followed to obtain a volatile organics composite sample which represented a two hour cycle of the caustic extraction columns and the chlorination stage column. The color, pH and COD were also measured for each of these composite samples collected.

Program Number 4

On Wednesday, March 5, 1980, the pilot plant was sampled and monitored through one complete cycle of the resin beds. This program was approximately the same as program number 3, except that sampling began at the same time the cycle began. The same compositing procedure for metals and semi-volatile organics was used for this program. Volatile organics samples were collected at 1000, 1100 and 1130 at each of the five sample locations.

Figure 18 outlines the resin beds operating modes throughout this sampling program. Samples were again collected every 30 minutes to obtain the metals and semi-volatile organics composites. The pH, temperature and pressure into and out of the caustic extraction columns and chlorination stage column were monitored at the same time that samples were collected (see Table 23).

Color, COD and pH were measured in each of the composite samples collected in this study.

Program Number 5

On Wednesday, March 5, 1980, a detailed sampling program was performed on the pilot plant ion exchange system.

During this analysis, the beds were operated in the normal mode, that is a fresh bed was run as second in a series for two hours and then transferred to first in the series for two more hours, then to elution, activation and backwash. The composite samples were taken from a single resin bed, number 1, regardless of its location, i.e., whether it was the first or second column. This detailed sampling program was arranged to determine the degradation of a single resin bed through the four hour period when it is actively treating the caustic extraction waste as the first or second bed in the series.

Figure 19 shows the operating modes of the resin beds at the time of the sampling program. Also included are the specific samples collected and

TABLE 22

PILOT PLANT ION EXCHANGE OPERATION
PARAMETERS MONITORED
SAMPLING PROGRAM NUMBER 3

Sampling Time	First Caustic Extraction Column In Series				Second Caustic Extraction Column In Series							Chlorination Column (Activation)						
	pH	Temperature (°C)	Pressure (kg/cm^2)		pH		Temperature (°C)		Flow (Liters/hr.)	Pressure (kg/cm^2)		pH		Temperature (°C)		Flow (Liters/hr.)	Pressure (kg/cm^2)	
			In	Out	In	Out	In	Out		In	Out	In	Out	In	Out		In	Out
1215	3.3	24.0	1.60	1.40	NA	3.3	24.5	23.5	64.3	1.60	1.20	1.9	NA	23.0	22.0	276.9	0.65	0.50
1245	3.5	25.0	1.55	1.40	3.3	3.3	25.0	24.0	80.0	1.80	1.20	1.9	9.7	24.0	24.0	276.9	0.65	0.55
1325	3.5	25.0	1.55	1.40	3.5	3.5	NA	25.0	70.6	1.65	1.20	1.9	1.9	24.5	24.0	276.9	0.75	0.50
1350	NA	NA	NA	NA	NA	3.0	NA	25.0	NA	NA	NA	1.9	1.9	24.5	24.5	276.9	0.75	0.50
1420	3.4	24.5	1.80	1.40	3.1	3.1	25.0	24.5	69.2	1.40	1.20	NA	NA	NA	NA	NA	NA	NA
1445	3.5	24.5	1.80	1.40	3.3	3.1	24.0	24.5	70.6	1.40	1.20	1.9	7.4	24.5	24.5	276.9	0.75	0.55
1515	3.4	24.5	1.90	1.40	3.4	2.9	24.0	24.0	76.6	1.40	1.20	2.0	1.9	24.0	24.0	257.1	0.75	0.50
1545	3.4	24.0	1.90	1.40	3.4	3.0	24.5	24.0	50.6	1.35	1.20	1.9	1.9	24.0	24.0	153.2	0.95	0.20
1615	3.4	24.0	1.60	1.40	3.2	3.2	24.0	24.0	72.0	1.60	1.20	1.9	1.9	23.0	23.0	119.2	NA	NA
1645	3.4	23.0	1.60	1.40	3.2	3.2	24.0	23.0	73.9	1.60	1.20	1.9	9.2	25.0	25.0	313.0	0.70	0.55
1715	3.4	23.0	1.60	1.40	3.4	3.1	23.0	23.0	72.0	1.70	1.20	1.9	2.5	25.0	25.0	297.5	0.70	0.50
1745	3.4	23.0	1.55	1.40	3.4	3.0	23.0	23.0	70.4	1.60	1.20	1.9	1.9	25.0	NA	198.9	0.85	0.20

Note: NA - Not Available

FIGURE 18
PILOT PLANT ION EXCHANGE OPERATION
MARCH 5, 1980 PROGRAM #4

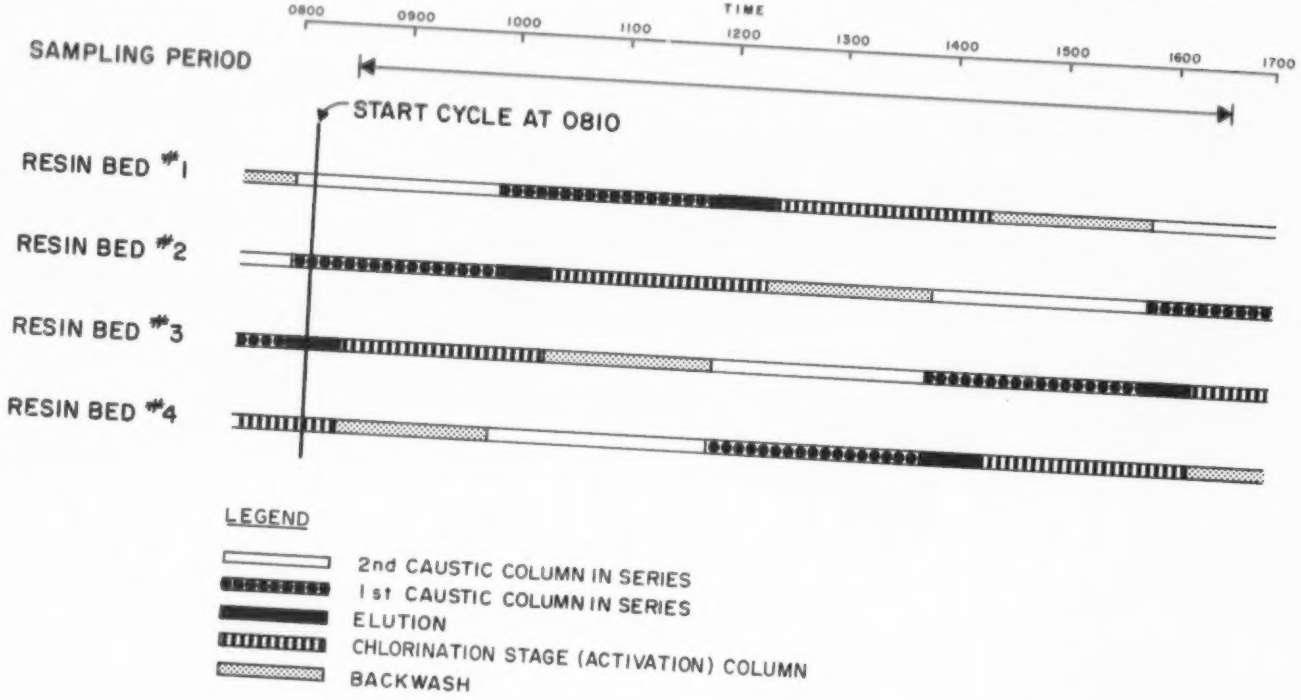


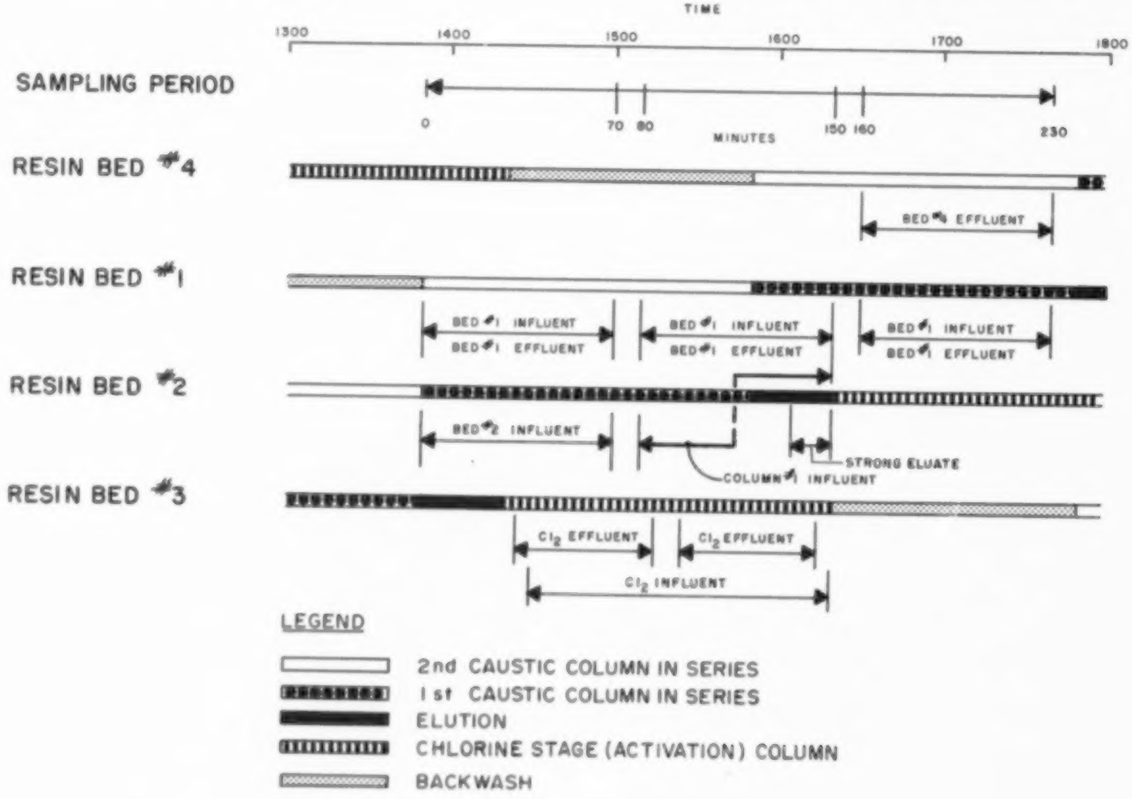
TABLE 23

PILOT PLANT ION EXCHANGE OPERATION
PARAMETERS MONITORED
SAMPLING PROGRAM NUMBER 4

Sampling Time	First Caustic Extraction Column In Series				Second Caustic Extraction Column In Series							Chlorination Column (Activation)						
	pH	Temperature (°C)	Pressure (kg/cm^2)		pH		Temperature (°C)		Flow (Liters/hr.)	Pressure (kg/cm^2)		pH		Temperature (°C)		Flow (Liters/hr.)	Pressure (kg/cm^2)	
			In	Out	In	Out	In	Out		In	Out	In	Out	In	Out		In	Out
0830	3.2	23.0	1.80	1.35	3.2	3.1	23.0	22.5	65.5	1.35	1.20	2.3	10.5	19.0	18.0	300.0	0.80	0.60
0900	3.3	23.0	1.80	1.30	3.2	3.1	23.0	22.5	63.2	1.35	1.15	2.0	5.7	23.0	23.0	300.0	0.45	0.35
0930	3.4	23.5	1.85	1.35	3.2	3.1	23.5	23.0	69.2	1.35	1.15	1.9	1.9	24.0	23.5	276.9	0.80	0.62
1000	3.4	23.5	1.55	1.35	3.4	3.1	23.5	14.5	58.1	1.60	1.10	1.9	1.9	24.5	24.5	276.9	NA	NA
1030	3.4	23.5	1.60	1.40	3.2	3.2	23.5	22.0	85.7	1.60	1.10	1.9	10.8	25.0	25.0	300.0	0.75	0.60
1100	3.4	22.5	1.55	1.40	3.3	3.1	22.5	23.0	69.2	1.60	1.20	2.0	6.5	25.0	25.0	276.9	0.80	0.60
1130	3.4	23.0	1.55	1.40	3.3	3.1	23.0	22.5	63.2	1.60	1.20	1.9	1.9	24.0	24.0	257.1	0.85	0.55
1200	3.4	NA	NA	NA	3.1	3.1	NA	NA	70.6	NA	NA	1.9	1.9	NA	NA	240.0	NA	NA
1240	3.4	23.5	1.80	1.35	3.2	3.2	23.5	23.0	72.0	1.35	1.20	1.9	7.2	25.0	25.0	276.9	0.72	0.58
1300	3.4	23.5	1.80	1.35	3.2	3.1	23.0	24.0	70.6	1.35	1.20	1.9	4.3	25.0	25.0	276.9	0.72	0.52
1330	3.4	24.0	1.80	1.35	3.2	3.0	24.0	23.0	69.2	1.40	1.20	1.9	1.9	25.0	25.0	257.1	0.78	0.42
1400	3.4	23.5	1.60	1.40	3.1	3.2	23.5	20.5	72.0	1.60	1.20	1.9	1.9	24.0	24.0	163.6	0.95	0.20
1430	3.4	25.0	1.60	1.40	3.1	3.1	24.0	23.0	67.9	1.60	1.20	1.9	10.5	24.5	24.5	276.9	0.65	0.55
1500	3.4	25.0	1.58	1.42	3.2	2.7	25.0	24.0	66.7	1.60	1.20	1.9	2.4	25.0	25.0	257.1	0.70	0.48
1530	3.4	25.0	1.60	1.40	3.3	2.9	25.0	24.5	72.0	1.65	1.20	1.9	1.9	25.0	25.0	211.8	0.75	0.32
1600	3.5	25.0	1.40	1.25	3.0	3.2	25.0	21.0	64.3	1.80	1.40	2.0	1.9	24.0	24.0	128.6	1.00	0.10
1630	3.5	25.0	1.80	1.40	3.1	3.0	25.0	24.0	67.9	1.40	1.20	1.9	9.0	25.5	25.5	240.0	0.60	0.40

Note: NA - Not Available

FIGURE 19
PILOT PLANT ION EXCHANGE OPERATION
MARCH 5, 1980 PROGRAM #5



the period over which they were collected at each resin bed. A one liter composite sample was made up from grab samples collected every 10 minutes throughout the composite period. The strong eluate sample was collected during the period in the elution cycle that contains the more heavily contaminated eluate (strong eluate).

One set of volatile organics samples was collected at the midpoint of each composite sample.

Program Number 6

On Thursday, March 6, 1980, a sampling program was performed on the pilot plant ion exchange system. The normal operation of the pilot plant was altered for this sampling program. Figure 20 shows the operating modes of the resin beds during this altered operation, as well as the samples collected.

The cycle was started at 0848 and one normal two-hour cycle took place. Samples were composited during this two-hour cycle for metals and semivolatile organics at the following locations:

Influent to 1st caustic extraction resin bed in series
Influent to 2nd caustic extraction resin bed column in series
Effluent from 2nd caustic extraction resin bed column in series

Two sets of volatile organics samples were also collected at each location at 0930 and 1025.

At 1048 the normal operating mode was altered. For the next four hours resin bed 1 remained as the 1st caustic extraction column in series; resin bed 4 remained as the 2nd caustic extraction column in series; and resin bed 2 remained as the chlorination stage column. The purpose of this sampling program was to determine the actual decrease in removal efficiency that results when the resin beds are overextended.

To accomplish this, two sets of composite samples were collected at the influent to the second caustic extraction column and the effluent from this column. These samples were divided into two hour composites with the first set representing the normal operation after two hours and the second composites representing the extended operating modes. In addition, compositing of the influent to the first caustic extraction column in series was continued, and a composite of the chlorination stage column effluent was collected for the total four-hour duration.

Four sets of volatile organic samples were collected at the four sample locations each hour.

The pH, temperature and pressure in and out of the columns was monitored during the sampling program (see Table 24).

FIGURE 20

PILOT PLANT ION EXCHANGE OPERATION
MARCH 6, 1980 PROGRAM #6

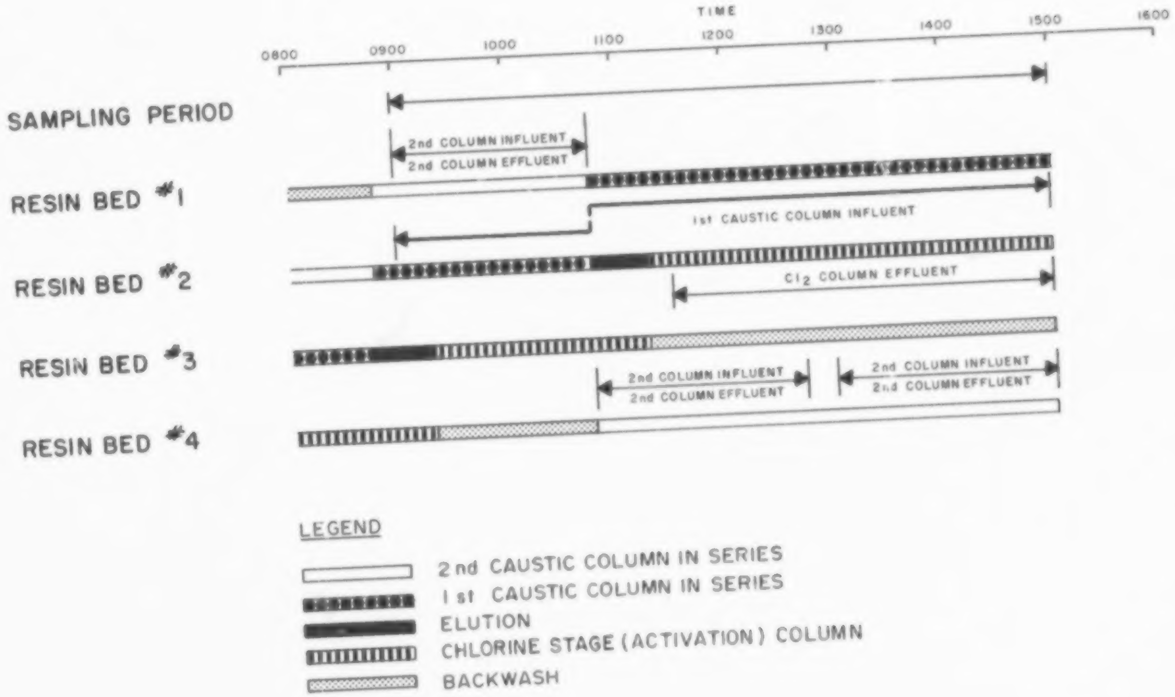


TABLE 24

PILOT PLANT ION EXCHANGE OPERATION
PARAMETERS MONITORED
SAMPLING PROGRAM NUMBER 6

Sampling Time	First Caustic Extraction Column In Series				Second Caustic Extraction Column In Series							Chlorination Column (Activation)						
	pH	Temperature (°C)	Pressure (kg/cm^2)		pH		Temperature (°C)		Flow (Liters/hr.)	Pressure (kg/cm^2)		pH		Temperature (°C)		Flow (Liters/hr.)	Pressure (kg/cm^2)	
			In	Out	In	Out	In	Out		In	Out	In	Out	In	Out		In	Out
0900	3.3	25.0	1.55	1.40	3.0	3.2	24.5	20.5	67.9	1.60	1.20	NA	NA	NA	NA	NA	NA	NA
0930	3.4	23.5	1.55	1.35	3.1	3.2	23.5	23.0	72.0	1.60	1.15	NA	NA	NA	NA	NA	NA	NA
1000	3.3	24.0	1.50	1.40	3.2	3.1	23.5	23.0	69.2	1.60	1.15	NA	NA	NA	NA	NA	NA	NA
1025	3.3	24.0	1.55	1.35	3.3	3.0	24.0	23.0	69.2	1.60	1.15	NA	NA	NA	NA	NA	NA	NA
1045	3.3	24.0	NA	NA	3.3	NA	24.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1100	3.3	23.0	1.80	1.40	3.0	3.4	23.0	13.5	61.0	1.40	1.25	NA	NA	NA	NA	NA	NA	NA
1130	3.3	23.0	1.80	1.35	3.1	3.2	23.0	22.5	70.6	1.35	1.20	NA	9.7	NA	25.0	276.9	0.75	0.60
1200	3.3	23.0	1.80	1.35	3.2	3.1	23.0	22.5	72.0	1.35	1.20	NA	3.6	NA	25.0	300.0	0.75	0.60
1240	3.3	22.5	1.80	1.35	3.3	3.0	22.5	22.0	67.9	1.35	1.20	NA	2.0	NA	24.0	276.9	0.72	0.55
1300	3.3	22.0	1.80	1.35	3.4	3.1	22.0	22.0	72.0	1.35	1.20	NA	2.0	NA	23.5	276.9	0.72	0.55
1330	3.4	22.5	1.80	1.35	3.4	3.2	22.5	22.0	69.2	1.35	1.20	NA	1.9	NA	23.0	276.9	0.75	0.50
1400	3.4	22.5	1.85	1.35	3.4	3.2	22.5	22.0	70.6	1.35	1.20	NA	1.9	NA	23.5	225.0	0.80	0.38
1430	3.4	22.5	1.85	1.35	3.4	3.3	22.5	22.0	67.9	1.35	1.20	NA	1.9	NA	24.0	156.5	0.95	0.18
1500	3.4	22.5	1.80	1.35	3.4	3.3	22.5	22.0	72.0	1.35	1.20	NA	1.9	NA	23.0	100.0	1.02	0.10

Note: NA - Not Available

Color, COD and pH of the eight composite samples collected during sampling program 6 were also measured.

Results and Discussion

Program 3 and 4. The analysis results obtained for sampling programs 3 and 4 can be found in Tables 25 through 30. These two programs are considered together because the same sampling and analysis techniques were used. The results indicate the magnitude of changes anticipated on a daily basis for the compounds which are readily removed by this treatment. In reviewing this data, it is necessary to recall the percent recoveries outlined in Tables 19 and 20 and use these values as a gauge of the confidence limits for the reported values for the volatile and semi-volatile organics.

It must be understood that as detection limits of the instrument (approximately 5 µg/l) are approached, the confidence limits increase; i.e., at 100 µg/l the confidence may be ±5 percent but at 6 µg/l the confidence may increase to say ±40 percent.

Removals are indicated for some volatile compounds, but the concentrations reported are near the detection limits and the confidence limits on these values preclude an accurate estimation of removal efficiency. Another problem encountered for some of these compounds appears to be saturation of the columns with weakly binding organics which can be displaced by strongly ionized molecules. Therefore, if weakly ionized organics are present, they can "saturate" the column and be eluted by stronger molecules. Thus, if the second column becomes saturated with weakly ionic organics and is then transferred to the first column position, the organics may be eluted by the incoming wastestream resulting in an increase in compounds noted across the column. This hypothesis assumes that the volatile organics are absorbed in the bound and eluted molecules.

The semi-volatile organics test results indicate that the chlorinated phenols and guaiacols are removed by this treatment. A comparison of the results noted for these two programs shows the removals of semi-volatile organic compounds to be similar. The resin and fatty acids and the phthalates do not appear to be affected by this treatment. This may be due to charge neutralization of the resin and fatty acids anions caused by the low influent pH, and a difference in non-ionic affinities of the resin and fatty acids as compared to the chloroguaiacols and chlorophenols for the resin and adsorbed materials on the resin.

Metal removal through complexation or chelation does not appear to be effective except for zinc and copper. These ions seem to be removed in the first caustic extraction column. An additional phenomenon is noted for the cadmium and nickel ions. It appears that these ions (probably in complex form) pass through the first ion exchange column with few or none removed, yet are removed almost totally in the second column. This occurs in program 3 for both compounds but does not occur for nickel ions in program 4. We can offer no explanation for this phenomenon.

Program 5. Tables 25 through 28 and Table 31, and Figures 21 through 25 present the results of the analysis of samples obtained in program 5. In this program samples were taken so that the effectiveness of one column could be gauged regardless of its location, as well as the removals through the complete plant during the sampling program. Another advantage of this program was that the strong eluate was sampled to indicate what compounds were being removed even when at or near instrument detection limits. Reference to the results for this sample will indicate empirically the compounds being reduced by the ion exchange treatment. It should be noted that the chlorination stage column removals indicated occur outside the treatment cycle during the activation cycle. These removals are not included in the overall removals reported.

The removal of metals during this program follows a similar pattern as that noted in programs 3 and 4. Reference should be made to this discussion for a review of the observed phenomena.

An interesting point was noted in reviewing the results for this sampling program. The removal efficiencies of dichlorophenol, trichloroguaiacol, and tetrachloroguaiacol increase with resin bed treatment time as noted by the effectiveness of removal with resin bed 1. A reason for this may be that in the acid pH range these compounds lose their ionic characteristics and, therefore, do not react with the resin through an ion exchange mechanism. These compounds are possibly being removed through an interaction with other materials being removed by the resin (note the reduction of color and COD). This may explain some of the inconsistencies noted in removal of some compounds through this entire program.

The lack of efficient removal of the resin and fatty acids at low pH is, however, predictable due to charge neutralization; but they are apparently not behaving like the chlorophenols and chloroguaiacols. It is certainly apparent that no hard and fast rules should be proposed from this study to predict removal of given compounds in complex matrices.

Additional research is necessary to firmly establish projected removal effectiveness of ion exchange treatment as at Billerud Uddeholm AB.

Program 6. Tables 25 through 28 and Table 32, and Figures 26 through 32 present the results from the samples obtained in this sampling program. The results obtained are similar to those found for the other sampling programs. The reader should note in Figure 27 that the removal efficiency decreases drastically in most cases toward the end of the treatment cycle. This program artificially extended the contact time on the resin columns in a given mode of operation. The results indicate that with this extended operation excessive amounts of conventional and toxic pollutants pass through the system into the wastestream. Shorter cycle times should be maintained to insure adequate removals.

TABLE 25

Volatile Organics, μg/1

	Methylene Chloride	Trichlorofluoromethane	1,1-Dichloroethane	Chloroform*	1,2-Dichloroethane	1,1,1-Trichloroethane	Bromodichloromethane	Trichloroethylene	Dibromochloromethane	Benzene	1,1,2,2-Tetrachloroethane	Tetrachloroethylene	Toluene	Chlorobenzene	Ethylbenzene
3/4/80 (Program 3)															
Influent	<1	ND	ND	7400	ND	ND	12	2.8	ND	4.0	ND	2.7	3.2	ND	ND
Column 2 Influent	<1	ND	ND	7300	ND	ND	7.6	5.5	ND	3.6	ND	2.1	3.1	ND	ND
Effluent	ND	ND	ND	4900	ND	ND	5.3	4.0	ND	2.7	ND	ND	4.5	ND	ND
Activation Influent	ND	ND	ND	7400	ND	ND	4.7	3.7	ND	2.2	ND	ND	3.1	ND	ND
Activation Effluent	ND	ND	ND	3400	ND	ND	3.1	5.7	ND	<1	ND	2.3	1.2	<1	ND
3/5/80 (Program 4)															
Influent	4.6	ND	ND	7000	ND	ND	6.9	2.5	ND	5.3	ND	2.2	3.4	ND	ND
Column 2 Influent	<1	ND	ND	7600	ND	ND	7.6	5.2	ND	3.0	ND	3.0	3.0	ND	ND
Effluent	<1	ND	ND	4800	ND	ND	ND	3.1	ND	3.1	ND	2.9	4.9	ND	ND
Activation Influent	<1	ND	ND	6000	ND	ND	5.3	4.0	ND	2.6	ND	ND	4.1	ND	ND
Activation Effluent	2.9	ND	ND	3700	ND	ND	4.9	4.9	ND	<1	ND	2.1	1.5	<1	ND
3/5/80 (Program 5)															
Bed 2 Influent, time 0-70 (Raw Waste)	ND	ND	ND	6100	ND	ND	7.6	5.2	ND	2.9	ND	2.6	5.8	ND	ND
Bed 1 Influent, time 0-70**	ND	ND	ND	5500	ND	ND	10	7.3	ND	ND	ND	3.7	6.7	ND	ND
Bed 1 Effluent, time 0-70	ND	ND	ND	5000	ND	ND	ND	5.2	ND	3.9	ND	4.1	2.0	ND	ND

Note: ND - Not Detected
*Done by direct injection
**Questionable sample-recoveries high

TABLE 25 (continued)

Volatile Organics, µg/l

3/5/80 (Program 5 cont.)	Methylene Chloride	Trichlorofluoromethane	1,1-Dichloroethane	Chloroform*	1,2-Dichloroethane	1,1,1-Trichloroethane	Bromodichloromethane	Trichloroethylene	Dibromochloromethane	Benzene	1,1,2,2-Tetrachloroethane	Tetrachloroethylene	Toluene	Chlorobenzene	Ethylbenzene
Activation Influent, time 40-150	ND	ND	ND	6000	ND	ND	5.3	4.9	ND	2.5	ND	3.7	2.9	ND	ND
Activation Effluent, time 35-85	<1	ND	ND	4000	ND	ND	5.1	2.6	ND	1.1	ND	2.4	2.4	ND	ND
Column 1 Influent, time 80-150 (Raw Waste)	ND	ND	ND	6600	ND	ND	15	4.0	ND	3.3	ND	4.1	4.1	ND	ND
Bed 1 Influent, time 80-150	<1	ND	ND	6800	ND	ND	5.3	5.7	ND	ND	ND	1.7	2.9	ND	ND
Bed 1 Effluent, time 80-150	ND	ND	ND	7600	ND	ND	9.9	6.1	ND	3.1	ND	2.3	2.0	ND	ND
Strong Eluate	ND	ND	ND	28000	ND	ND	ND	82	ND	ND	ND	3.3	5.2	ND	ND
Activation Effluent, time 95-135	ND	ND	ND	3700	ND	ND	6.1	6.4	ND	2.2	ND	5.2	3.4	ND	ND
Bed 1 Influent, time 160-230 (Raw Waste)	1.7	ND	ND	7500	ND	ND	15	4.0	ND	2.2	ND	4.1	2.5	ND	ND
Bed 1 Effluent, time 160-230	<1	ND	ND	7600	ND	ND	6.8	5.5	ND	ND	ND	3.1	4.5	ND	ND
Bed 4 Effluent, time 160-230	<1	ND	ND	6600	ND	ND	4.6	7.3	ND	2.6	ND	3.2	3.4	1.3	ND

Note: ND - Not Detected
*Done by direct injection

TABLE 25 (continued)

Volatile Organics, μg/l

3/6/80 (Program 6)	Methylene Chloride	Trichlorofluoromethane	1,1-Dichloroethane	Chloroform*	1,2-Dichloroethane	1,1,1-Trichloroethane	Bromodichloromethane	Trichloroethylene	Dibromochloromethane	Benzene	1,1,2,2-Tetrachloroethane	Tetrachloroethylene	Toluene	Chlorobenzene	Ethylbenzene
Column Influent	ND	ND	ND	8100	ND	ND	6.1	2.2	ND	1.8	ND	3.4	3.2	ND	ND
Column 2 Influent^{o}	ND	ND	ND	8400	ND	ND	13	5.5	ND	3.5	ND	3.2	3.6	ND	ND
Column 2 Effluent^{o}	ND	ND	ND	5400	ND	ND	6.1	4.0	ND	2.7	ND	2.7	3.8	ND	ND
Column 2 Influent^{o}	ND	ND	ND	7300	ND	ND	8.9	3.7	ND	ND	ND	3.0	3.2	ND	ND
Column 2 Effluent^{o}	ND	ND	ND	5200	ND	ND	6.4	3.7	ND	3.1	ND	2.3	3.6	ND	ND
Column 2 Influent^{+}	ND	ND	ND	9200	ND	ND	7.2	4.0	ND	4.3	ND	1.4	3.4	ND	ND
Column 2 Effluent^{+}	<1	ND	ND	6700	ND	ND	5.9	5.2	ND	2.7	ND	ND	3.8	ND	ND
Activation Column Effluent	<1	ND	ND	4000	ND	ND	3.8	2.9	ND	1.2	ND	2.7	3.5	<1	ND

Note: ND - Not Detected
*Done by direct injection
^{o}Normal plant operation
$^{+}$Extended cycle time

TABLE 26

Semi-Volatile Organics, µg/l

	2,4-Dichlorophenol	2,4,6-Trichlorophenol	2,3,5-Trichlorophenol	Diethylphthalate	Trichloroguaiacol	Tetrachloroguaiacol	Dibutyl phthalate	Heptadecanoic acid	Dehydroabietic acid	Heneicosanic acid (C21:0)	Chlorodehydroabietic acid (A)	Bis (2-Ethylhexyl) phthalate	Chlorodehydroabietic acid (B)	Dichlorodehydroabietic acid	Dioctylphthalate	9,10-Dichlorostearic acid
3/4/80 (Program 3)																
Influent	42	91	14*	ND	280	100	8.6	88	6.5	260	8.8	10	25	23	ND	17
Column 2 Influent'	2.7	7.8	ND	ND	63	22	9.4	55	11	420	11	7.5	28	28	ND	14
Effluent	ND	5.2	ND	ND	31	22	8.1	120	8.0	ND	14	16	39	66	ND	53
Activation Influent	3.5	8.3	3.8*	ND	8	120	2.0	ND	ND	ND	ND	10	2.2	3.5	ND	4.8
Activation Effluent	ND	2.0	ND	ND	45	14	6.5	48	ND	ND	ND	100	ND	ND	ND	ND
3/5/80 (Program 4)																
Influent	38	80	10*	ND	130	100	1.2	17	11	ND	4.0	91	17	12	ND	5.8
Column 2 Influent	2.0	10	ND	ND	39	23	3.1	29	10	110	9.2	190	22	18	ND	6.8
Effluent	ND	10	ND	ND	28	18	2.6	48	5.7	ND	11	13	23	30	ND	18
Activation Influent	2.0	23	3.1*	2.0	79	83	2.3	60	ND	ND	1.1	75	3.7	3.7	ND	ND
Activation Effluent	1.0	4.0	ND	ND	42	17	2.0	ND	ND	ND	ND	74	2.1	2.0	ND	3.8
3/5/80 (Program 5)																
Bed 2 Influent, time 0-70 (Raw Waste)	38	54	ND	ND	220	90	2.4	34	14	460	7.9	ND	19	19	ND	ND
Bed 1 Influent, time 0-70	ND	ND	ND	ND	63	23	3.5	28	12	ND	9.0	100	22	22	ND	ND
Bed 1 Effluent, time 0-70	ND	19	ND	ND	33	15	2.5	67	7.1	150	18	120	41	78	ND	20

Note: ND - Not detected
*Possibly another trichlorophenol isomer
'Questionable sample - high recovery of pentafluorophenol spike

TABLE 26 (continued)

Semi-Volatile Organics, μg/l

	2,4-Dichlorophenol	2,4,6-Trichlorophenol	2,3,5-Trichlorophenol	Diethylphthalate	Trichloroguaiacol	Tetrachloroguaiacol	Dibutyl phthalate	Heptadecanoic acid	Dehydroabietic acid	Heneicosanic acid (C21:0)	Chlorodehydroabietic acid (A)	Bis (2-Ethylhexyl) phthalate	Chlorodehydroabietic acid (B)	Dichlorodehydroabietic acid	Dioctylphthalate	9,10-Dichlorostearic acid
3/5/80 (Program 5 cont.)																
Activation Influent, time 40-150	2.4	4.3	4.1*	ND	92	89	3.5	12	ND	ND	ND	190	2.7	3.0	ND	3.5
Activation Effluent, time 35-85	ND	16	ND	ND	34	20	1.6	ND	ND	19	1.1	50	2.6	2.3	ND	ND
Column 1 Influent, time 80-150 (Raw Waste)	55	47	14*	ND	200	120	ND	19	12	ND	5.2	24	15	12	ND	ND
Bed 1 Influent, time 80-150	17	44	8.1*	ND	150	68	1.4	21	18	ND	12	86	28	21.1	ND	7.3
Bed 1 Effluent, time 80-150	2.2	51	ND	ND	67	33	3.3	32	14	180	13	130	28	32	ND	ND
Strong Eluate	400	300	62*	ND	11000	3600	20	1200	48	ND	27	2500	69	91	ND	110
Activation Effluent, time 95-135	3.8	5.7	ND	3.4	51	18	6.5	ND	ND	ND	ND	220	ND	ND	ND	ND
Bed 1 Influent, time 160-230 (Raw Waste)	52	120	28*	ND	310	109	26	16	14	47	8.3	17	18	14	ND	ND
Bed 1 Effluent, time 160-230	ND	20	ND	ND	71	28	2.3	ND	16	14	9.0	76	21	18	ND	4.6
Bed 4 Effluent, time 160-230	ND	13	ND	ND	42	18	2.3	49	7.2	ND	11	86	27	29	ND	21
3/6/80 (Program 6)																
Column Influent	27	39	ND	ND	240	84	1.3	98	3.3	31	12	82	26	11	ND	6.1
Column 2 Influent°	ND	6.9	ND	ND	47	20	1.9	15	5.0	ND	4.5	34	11	16	ND	ND
Column 2 Effluent°	ND	5.1	ND	ND	23	7.3	1.6	28	ND	ND	3.8	210	8.7	14	48	6.9
Column 2 Influent°	ND	5.7	ND	ND	39	11	1.4	62	2.2	ND	6.0	190	13	24	37	39
Column 2 Effluent°	ND	ND	ND	ND	19	6.2	4.4	18	2.6	ND	5.6	77	11	36	ND	28
Column 2 Influent+	ND	8.4	ND	ND	49	24	3.4	12	3.0	ND	2.6	12	6.3	5.4	ND	5.4
Column 2 Effluent+	1.4	6.8	ND	ND	60	19	1.6	32	2.2	ND	3.1	9.3	3.5	1.8	ND	ND
Activation Column Effluent	3.9	10	ND	ND	43	26	1.1	ND	ND	ND	ND	56	ND	ND	ND	ND

Note: *Possibly another trichlorophenol isomer
ND - Not detected
°Normal operation
+Extended cycle time

TABLE 27

METALS, μg/l

	Sb	As	Be	Cd	Cr	Cu	Pb	Ni	Se	Ag	Tl	Zn	Hg
3/4/80 (Program 3)													
Influent	<3	8	<0.5	620	32	25	3	100	5	1.3	<2	160	0.21
Column 2 Influent	<3	5	<0.5	670	29	20	2	160	<4	0.9	<2	140	0.25
Effluent	<3	3	<0.5	0.6	13	7	<1	17	<4	<0.5	9	110	0.09
Activation Influent	<3	<2	<0.5	2.5	51	44	3	<5	<4	0.6	8	490	0.08
Activation Effluent	<3	<2	<0.5	2.8	5	59	4	<5	<4	<0.5	<5	490	0.01
3/5/80 (Program 4)													
Influent	<3	6	<0.5	440	32	38	2	15	6	0.6	38	170	0.24
Column 2 Influent	<3	6	<0.5	490	29	20	<1	10	6	0.9	33	120	0.29
Effluent	<3	<2	<0.5	0.9	17	7	<1	46	<4	<0.5	23	10	0.15
Activation Influent	<3	<2	<0.5	2.3	39	46	5	54	<4	<0.5	<2	470	0.03
Activation Effluent	<3	<2	<0.5	2.4	15	41	5	32	<4	<0.5	<2	610	0.03
3/5/80 (Program 5)													
Bed 2 Influent, time 0-70 (Raw Waste)	<3	9	<0.5	270	35	20	<1	120	6	1.1	12	70	0.27
Bed 1 Influent, time 0-70	<3	6	<0.5	320	29	49	<1	70	<4	1.6	16	130	0.22
Bed 1 Effluent, time 0-70	<3	<2	<0.5	1.2	5	4	<1	<5	<4	<0.5	18	110	0.14

TABLE 27 (continued)

METALS, µg/1

	Sb	As	Be	Cd	Cr	Cu	Pb	Ni	Se	Ag	Tl	Zn	Hg
3/5/80 (Program 5 cont.)													
Activation Influent, time 40-150	<3	<2	<0.5	2.9	42	24	4	<5	<4	<0.5	<2	470	5.7
Activation Effluent, time 35-85	<3	<2	<0.5	2.0	10	38	2	<5	<4	<0.5	<2	470	0.03
Column 1 Influent, time 80-150 (Raw Waste)	<3	7	<0.5	160	28	33	2	<5	<4	0.7	49	160	0.15
Bed 1 Influent, time 80-150	<3	7	<0.5	190	31	25	2	98	51	0.9	21	140	0.18
Bed 1 Effluent, time 80-150	<3	<2	<0.5	140	30	11	<1	86	6	0.8	14	110	0.13
Strong Eluate	53	140	16	280	1200	56	11	400	56	15	26	390	18.10
Activation Effluent, time 95-135	<3	<2	<0.5	2.6	32	39	3	14	<4	<0.5	<2	520	0.05
Bed 1 Influent, time 160-230 (Raw Waste)	<3	7	<0.5	230	36	26	2	230	5	0.8	26	160	0.15
Bed 1 Effluent, time 160-230	<3	10	<0.5	180	34	12	<1	130	6	1.4	34	120	0.17
Bed 4 Effluent, time 160-230	<3	3	<0.5	0.6	22	5	21	110	<4	<0.5	16	110	0.09

TABLE 27 (continued)

METALS, g/l

	Sb	As	Be	Cd	Cr	Cu	Pb	Ni	Se	Ag	Tl	Zn	Hg
3/6/80 (Program 6)													
Column Influent	3	5	0.5	380	31	25	2	19	6	1.0	31	170	0.26
Column 2 Influent°	3	6	0.5	5.9	33	30	1	8	4	1.0	35	120	0.23
Column 2 Effluent°	3	3	0.5	0.6	25	5	1	5	4	0.5	23	110	0.14
Column 2 Influent°	3	7	0.5	190	30	9	1	5	4	0.7	20	140	0.15
Column 2 Effluent°	3	2	0.5	0.8	22	4	1	5	4	0.5	14	98	0.07
Column 2 Influent+	3	6	0.5	180	28	16	2	5	4	1.2	2	130	0.20
Column 2 Effluent+	3	6	0.5	0.8	38	21	2	40	4	0.8	2	120	0.18
Activation Column Effluent	3	3	0.5	3.6	73	26	8	33	4	0.5	2	850	0.03

Note: °Normal operation
+Extended cycle time

TABLE 28

Color, COD, Chlorides, pH

	Color (color units)	COD (mg/l)	Cl^- (mg/l)	pH
3/4/80 (Program 3)				
Influent	12700	2400	1500	3.3
Column 2 Influent	6670	1500	1600	3.2
Effluent	1210	790	1900	2.8
Activation Influent	890	660	1200	1.8
Activation Effluent	330	480	1000	2.0
3/5/80 (Program 4)				
Influent	12000	3000	1500	3.2
Column 2 Influent	6970	2300	1700	3.0
Effluent	1240	700	1900	2.8
Activation Influent	990	600	1100	1.8
Activation Effluent	390	450	810	2.1
3/5/80 (Program 5)				
Bed 2 Influent, time 0-70 (Raw Waste)	11900	3000	1400	3.4
Bed 1 Influent, time 0-70	6400	2200	1700	3.1
Bed 1 Effluent, time 0-70	510	560	2200	3.0

TABLE 28 (continued)

Color, COD, Chlorides, pH

	Color (color units)	COD (mg/l)	Cl^- (mg/l)	pH
3/5/80 (Program 5 cont.)				
Activation Influent, time 40-150	930	610	1200	1.9
Activation Effluent, time 35-85	340	390	580	4.3
Column 1 Influent, time 80-150 (Raw Waste)	11200	2800	1500	3.4
Bed 1 Influent, time 80-150	9890	2700	1600	3.3
Bed 1 Effluent, time 80-150	3450	1500	1800	2.9
Strong Eluate	330000	58000	15000	11.9
Activation Effluent, time 95-135	460	470	1200	2.0
Bed 1 Influent, time 160-230 (Raw Waste)	11400	2900	1500	3.4
Bed 1 Effluent, time 160-230	7870	2400	1600	3.2
Bed 4 Effluent, time 160-230	1180	740	1900	2.9
3/6/80 (Program 6)				
Column Influent	12200	3100	1600	3.2
Column 2 Influent°	7530	2500	1800	3.1
Column 2 Effluent°	1240	800	2200	2.9
Column 2 Influent°	7190	2300	1800	3.1
Column 2 Effluent°	1280	780	2000	2.9
Column 2 Influent+	9810	2900	1700	3.2
Column 2 Effluent+	6440	2300	1800	3.1
Activation Column Effluent	550	510	1100	1.9

Note: °Normal operation
+Extended cycle time

TABLE 29

Pilot Plant Ion-Exchange System
Percent Removals

Program Number 3

Compound	Column 1°	Column 2°	Overall+	Activation Column
Color	48	82	90	64
COD	38	47	67	27
Mercury	*	65	57	88
Copper	20	65	72	*
Zinc	13	21	31	No Removal
2,4-Dichlorophenol	94	100	100	100
2,4,6-Trichlorophenol	91	33	94	76
Trichloroguaiacol	78	51	89	*
Tetrachloroguaiacol	78	0	78	88

Note:

*Denotes an increase in this compound concentration across this column.

°Percent Removal =

$$\frac{\text{component concentration in column feed} - \text{component concentration in column discharge}}{100}$$

+Overall Percent Removal =

$$\frac{\text{component concentration in column \#1 feed} - \text{component concentration in column \#2 discharge}}{100}$$

TABLE 30

Pilot Plant Ion-Exchange System
Percent Removals

Program Number 4

Compound	Column 1^{o}	Column 2^{o}	Overall^{+}	Activation Column
Color	42	82	90	61
COD	23	70	77	25
Mercury	*	48	38	0
Copper	47	65	82	No Removal
Zinc	29	92	94	No Removal
2,4-Dichlorophenol	95	100	100	50
2,4,6-Trichlorophenol	88	0	88	83
Trichloroguaiacol	70	28	78	47
Tetrachloroguaiacol	77	22	82	80

Note:

*Denotes an increase in this compound concentration across this column.

^{o}Percent Removal =

$$\frac{\text{component concentration in column feed-component concentration in column discharge}}{100}$$

$^{+}$Overall Percent Removal =

$$\frac{\text{component concentration in column \#1 feed-component concentration in column \#2 discharge}}{100}$$

TABLE 31

Pilot Plant Ion Exchange System
Percent Removals

Program Number 5

Compound	Column 1° Time 0-70	* Column 2° Time 0-70	Overall+ Time 0-70	Column 1° Time 80-150	* Column 2° Time 80-150	Overall+ Time 80-150	* Column 1° Time 160-230	Column 2° Time 160-230	Overall+ Time 160-230	Activation Effluent Time	
										35-85	95-145
Color	46	92	96	11	65	69	31	85	90	63	51
COD	27	75	81	4	44	46	17	69	74	36	23
Mercury	19	36	48	**	28	13	**	47	40	99	99
2,4,-Dichlorophenol	100	100	100	51	87	96	100	100	100	100	**
2,4,6-Trichlorophenol	100	**	65	6	**	**	83	35	89	**	**
Trichloroguaiacol	71	48	85	25	55	67	77	41	86	63	45
Tetrachloroguaiacol	74	35	83	43	51	73	74	36	83	78	10

Note:

*Indicates the location of Resin Bed #1 through this analysis.

**Indicates an increase in the compounds concentration across this treatment step.

°Percent Removal = $\frac{\text{component concentration in column feed-component concentration in column discharge}}{100}$

+Overall Percent Removal = $\frac{\text{component concentration in column \#1 feed-component concentration in column \#2 discharge}}{100}$

TABLE 32

Pilot Plant Ion Exchange System
Percent Removals

Program Number 6

Compound	Normal Operation			Normal Operation			Extended Cycle Time		
	Column 1[o] 8:48-10:48	Column 2[o] 8:48-10:48	Overall[+] 4:48-10:48	Column 1[o] 10:48-12:48	Column 2[o] 10:48-12:48	Overall[+] 10:48-12:48	Column 1[o] 13:00-15:00	Column 2[o] 13:00-15:00	Overall[+] 13:00-15:00
Color	38	83	90	41	82	90	20	34	47
COD	19	68	74	26	66	75	6	21	26
Mercury	12	39	46	42	53	73	23	10	31
Copper	*	83	80	64	56	84	36	*	16
Zinc	29	8	35	18	30	42	24	8	29
2,4,6-Trichlorophenol	82	26	87	85	100	100	78	19	83
Trichloroguaiacol	30	51	90	84	51	92	80	*	75
Tetrachloroguaiacol	76	64	91	87	44	93	71	21	77

Note:

*Indicates an increase in the compounds concentration across this treatment step.

[o] Percent Removal = $\frac{\text{component concentration in column feed-component concentration in column discharge}}{100}$

[+] Overall Percent Removal = $\frac{\text{component concentration in column \#1 feed-component concentration in column \#2 discharge}}{100}$

FIGURE 21
PILOT PLANT REMOVALS

COLOR PROGRAM #5

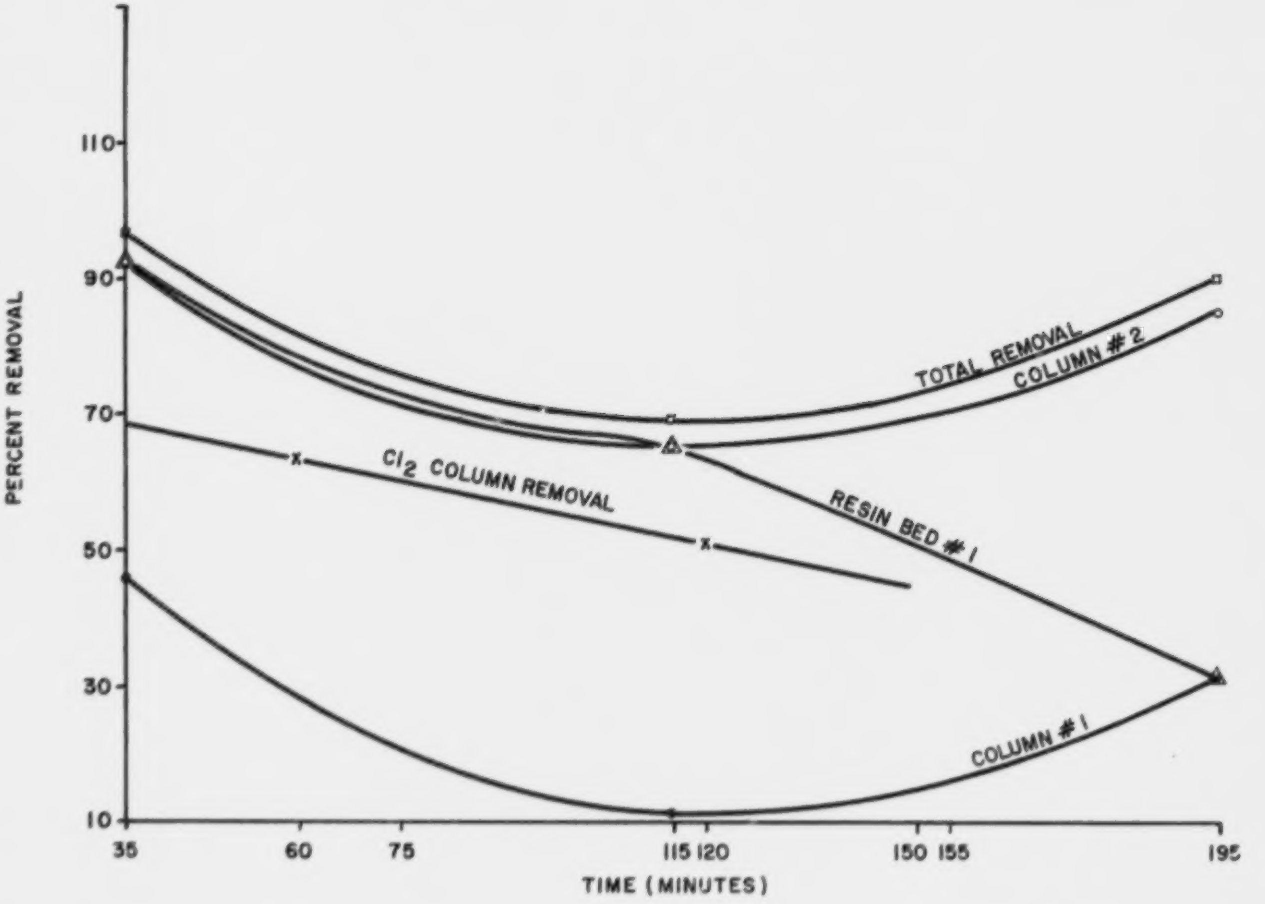


FIGURE 22
PILOT PLANT REMOVALS

COD PROGRAM #5

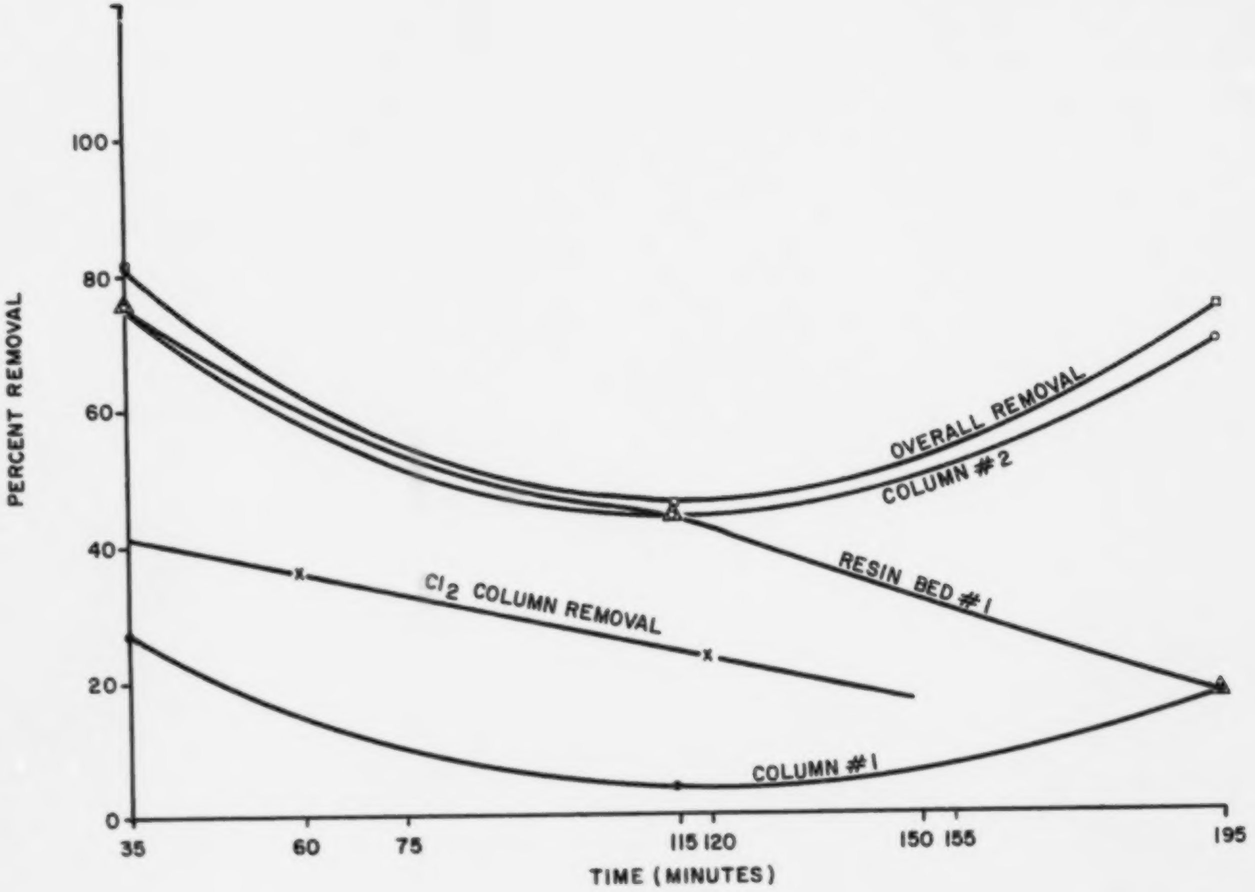


FIGURE 23
PILOT PLANT REMOVALS
2,4-DICHLOROPHENOL PROGRAM #5

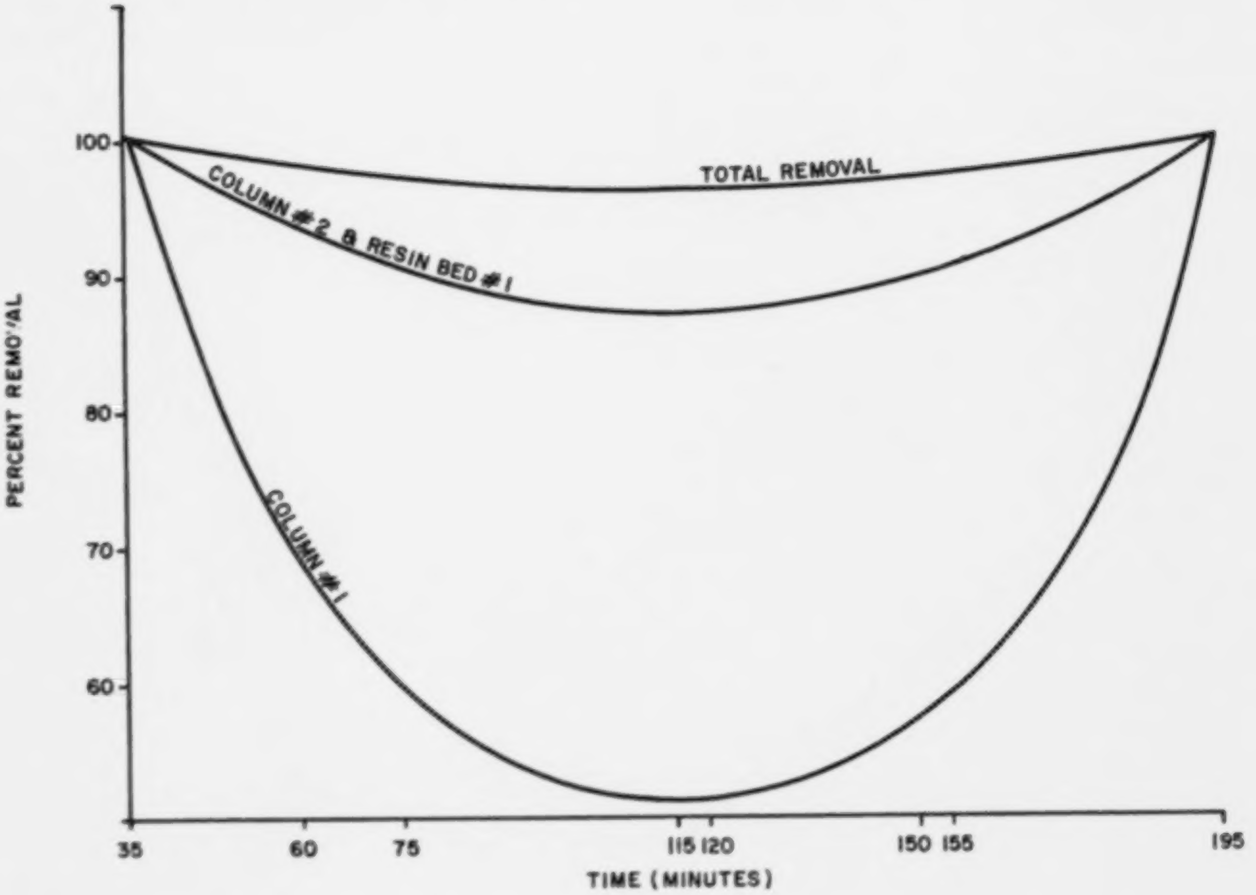


FIGURE 24
PILOT PLANT REMOVALS
TRICHLOROGUAIACOL PROGRAM #5

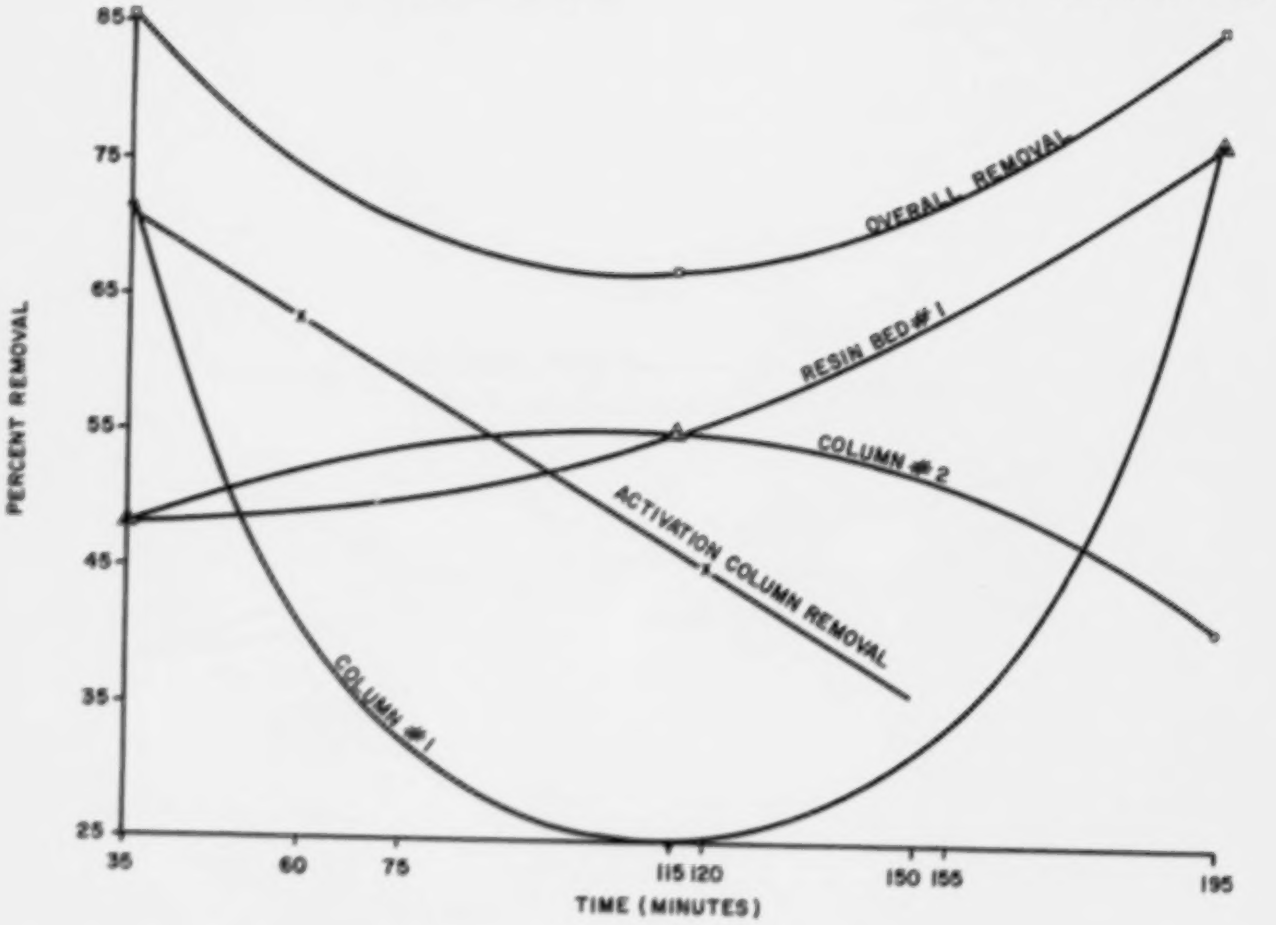


FIGURE 25
PILOT PLANT REMOVALS
TETRACHLOROGUAIACOL PROGRAM #5

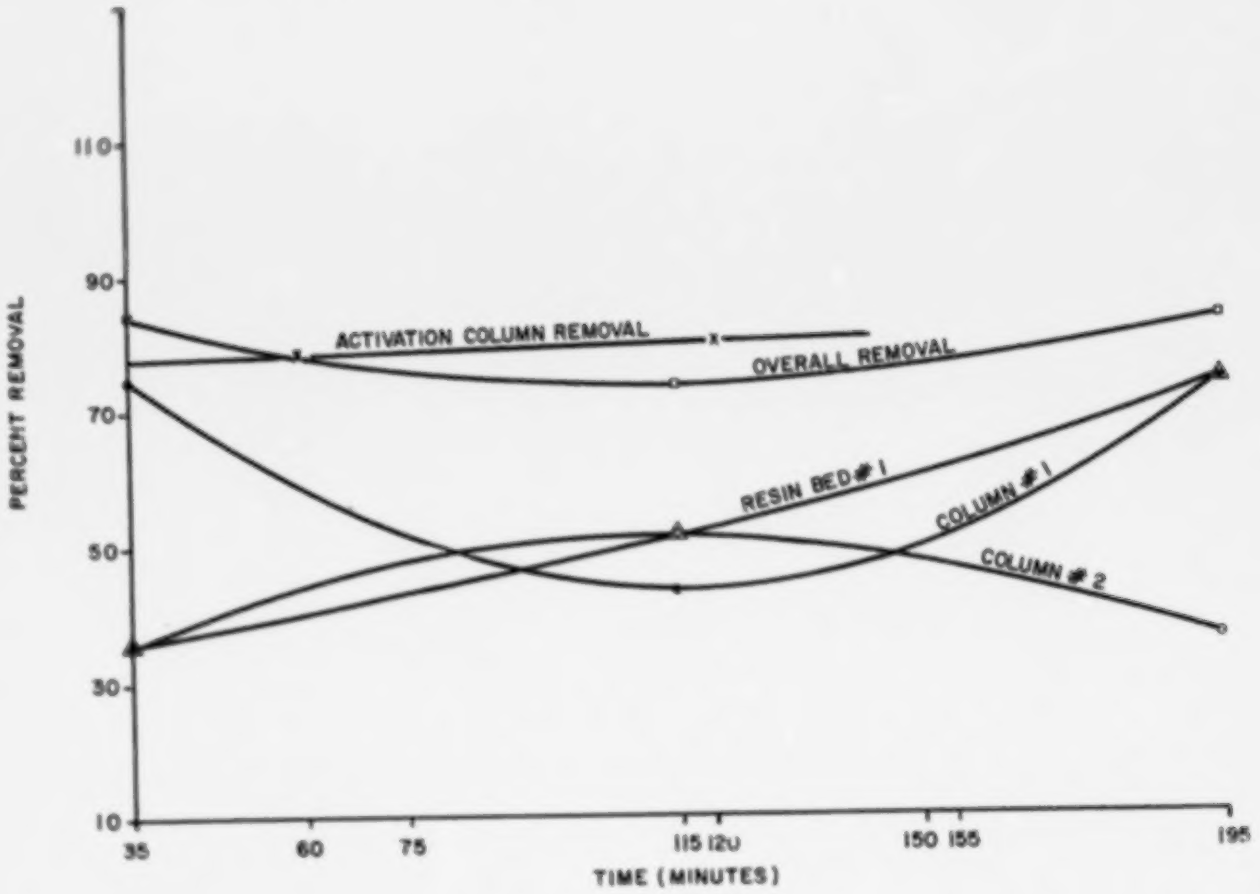


FIGURE 26
PILOT PLANT REMOVALS

COLOR PROGRAM #6

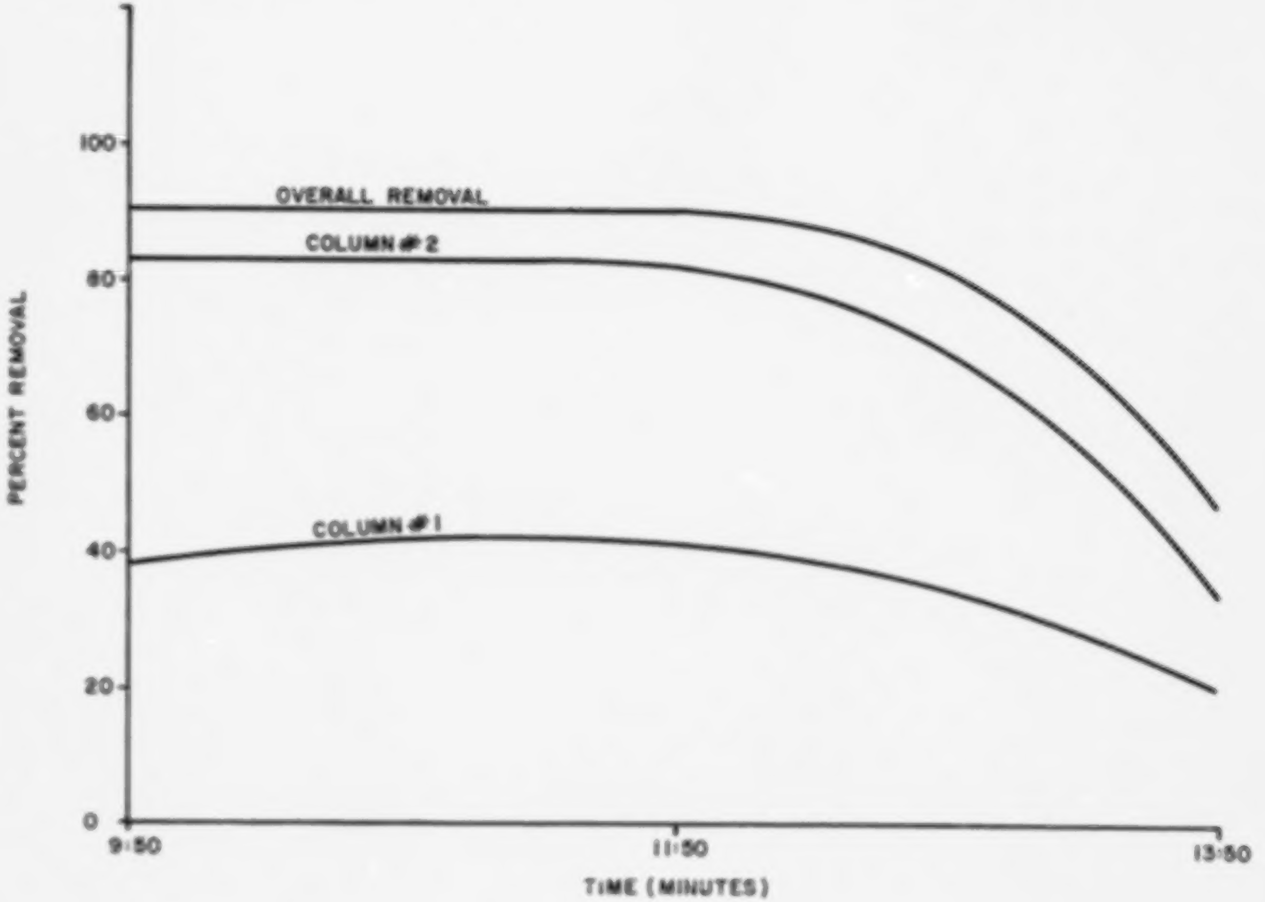


FIGURE 27
PILOT PLANT REMOVALS

COD PROGRAM #6

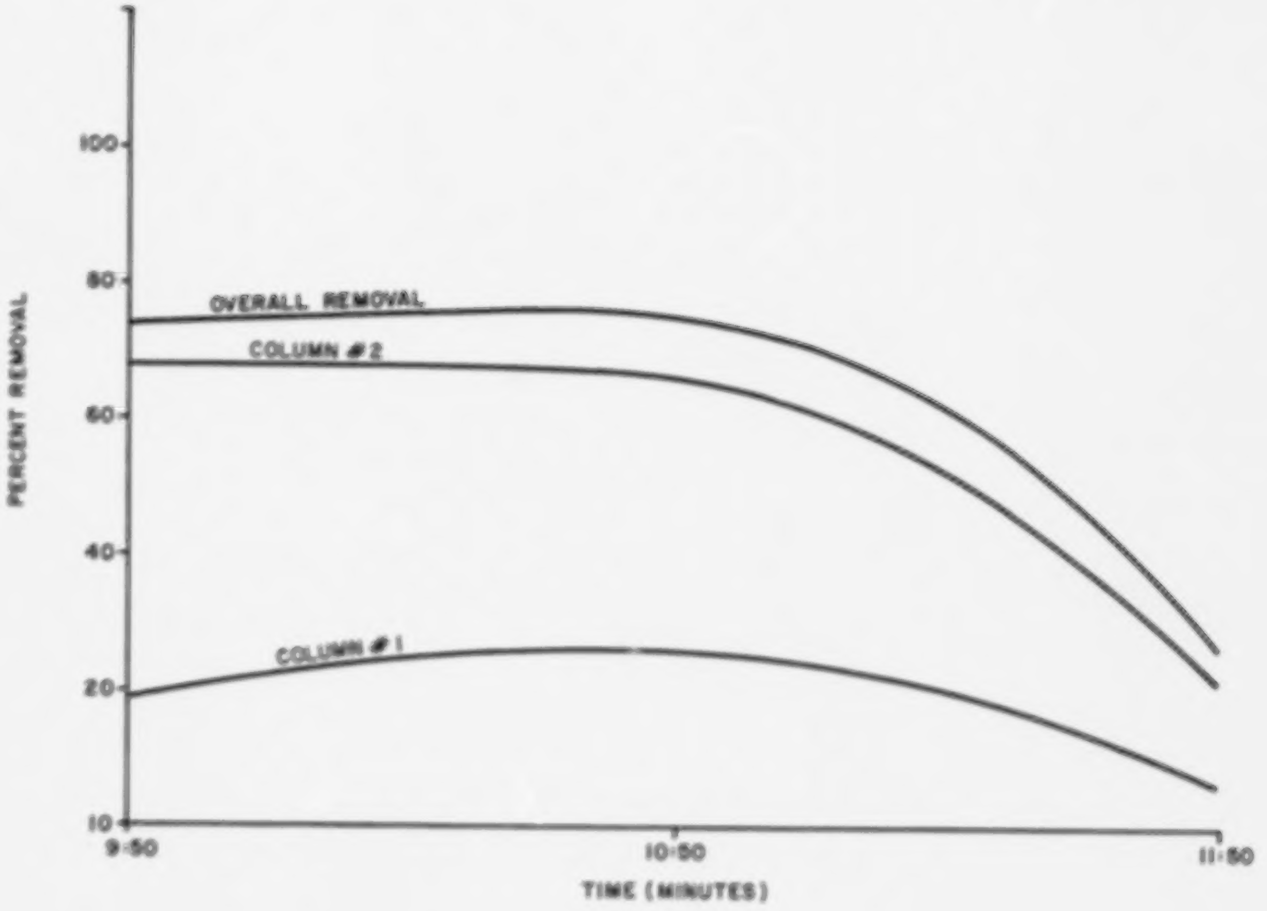


FIGURE 28
PILOT PLANT REMOVALS

MERCURY

PROGRAM #6

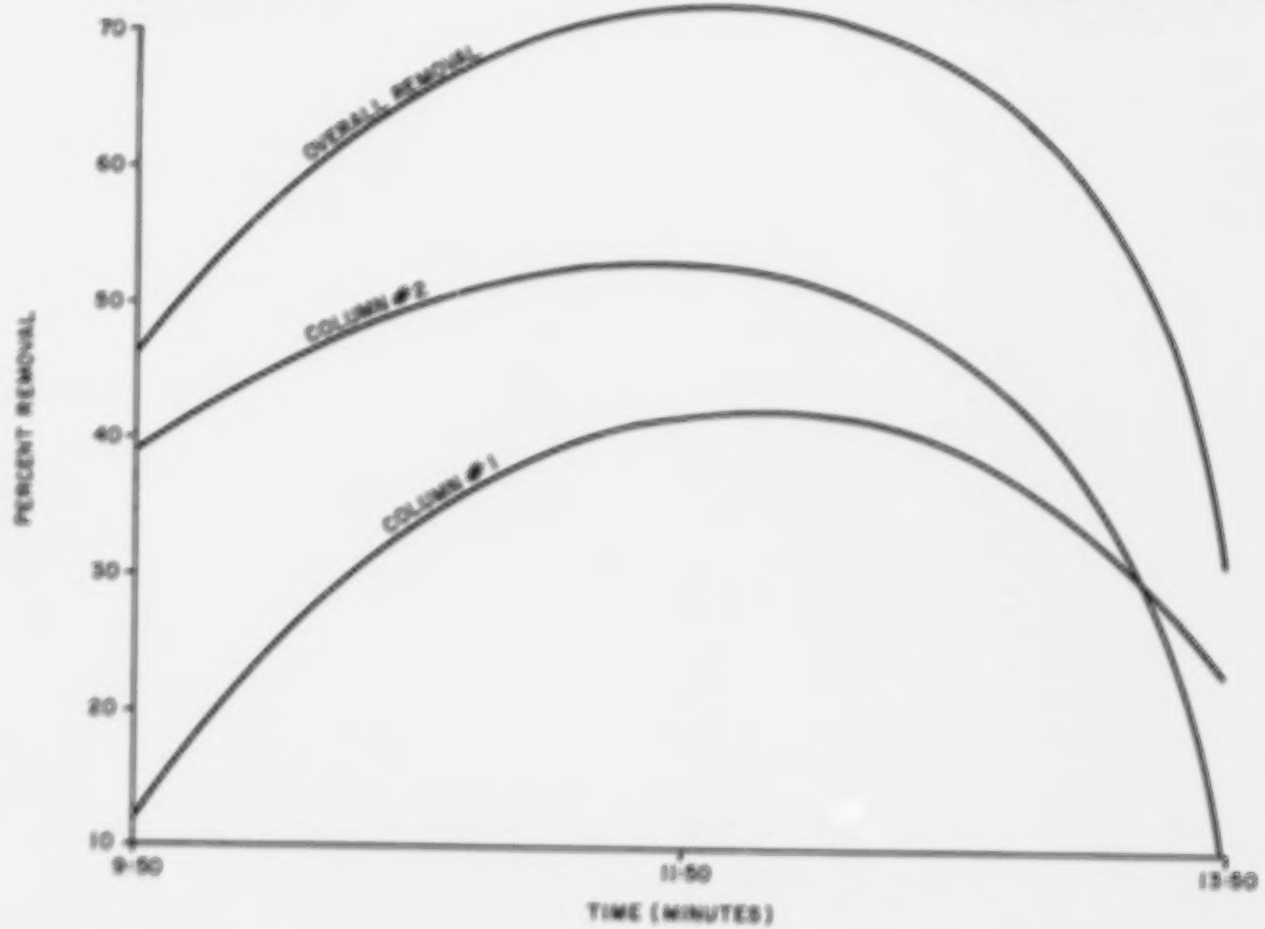


FIGURE 29
PILOT PLANT REMOVALS

CADMIUM PROGRAM #6

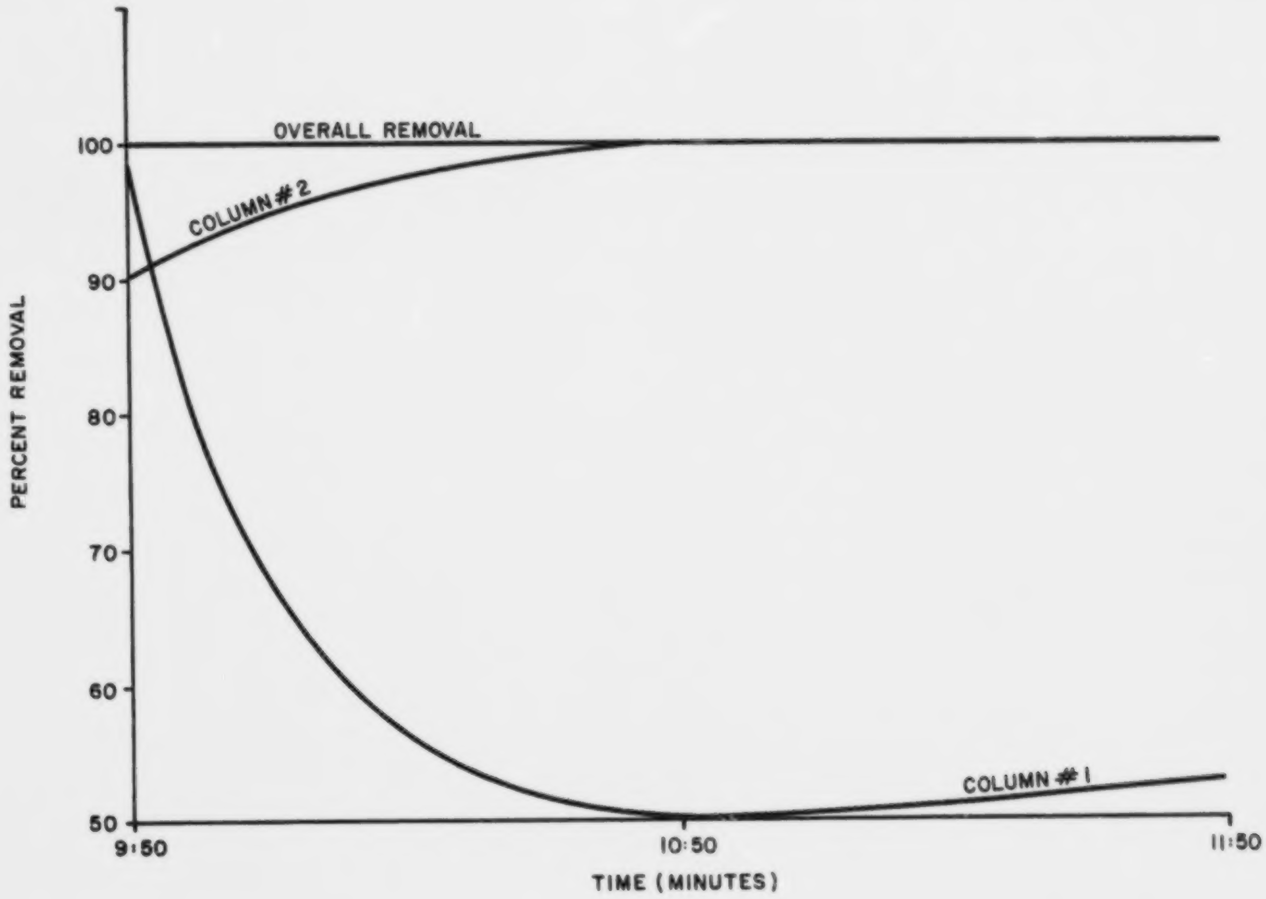


FIGURE 30
PILOT PLANT REMOVALS
2,4,6-TRICHLOROPHENOL PROGRAM #6

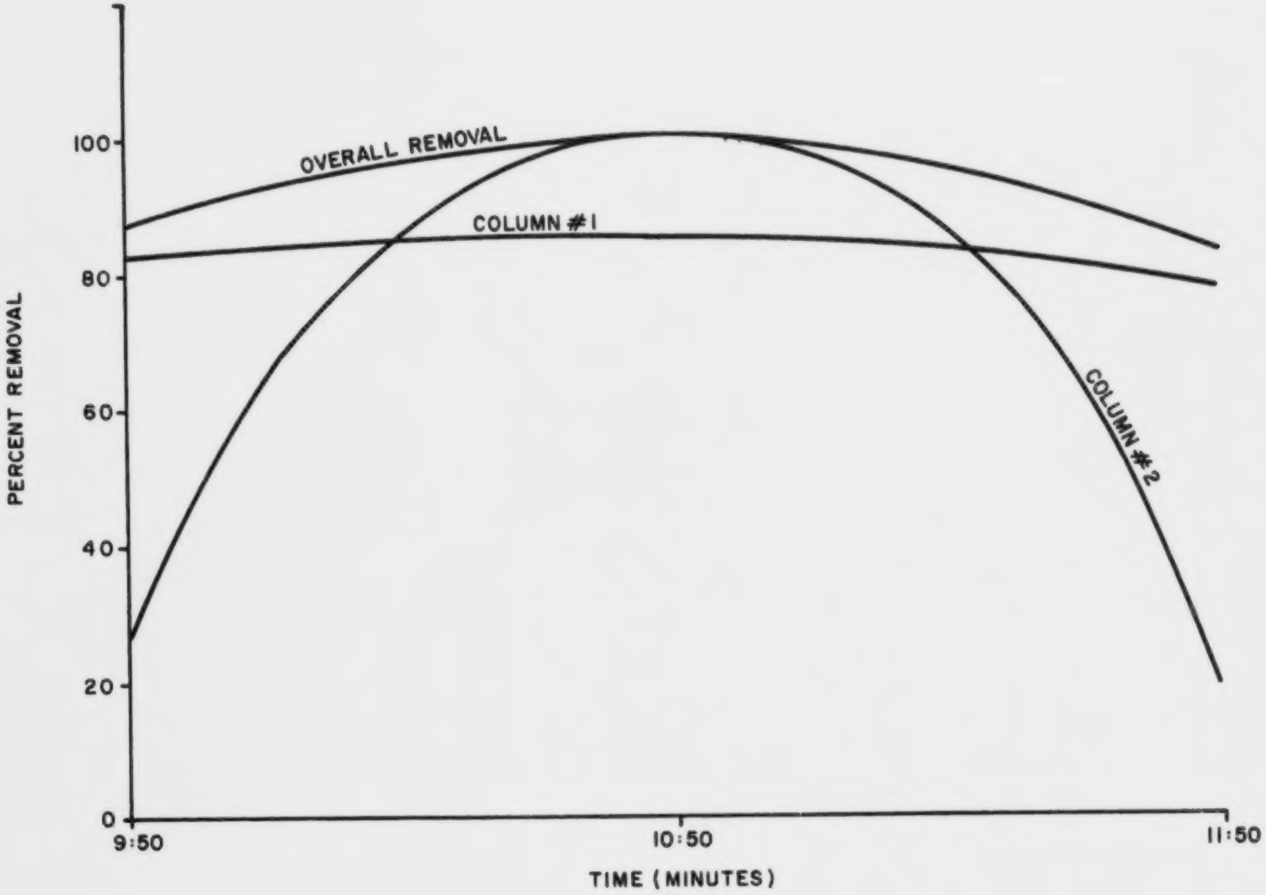


FIGURE 31
PILOT PLANT REMOVALS
TRICHLOROGUAIACOL PROGRAM #6

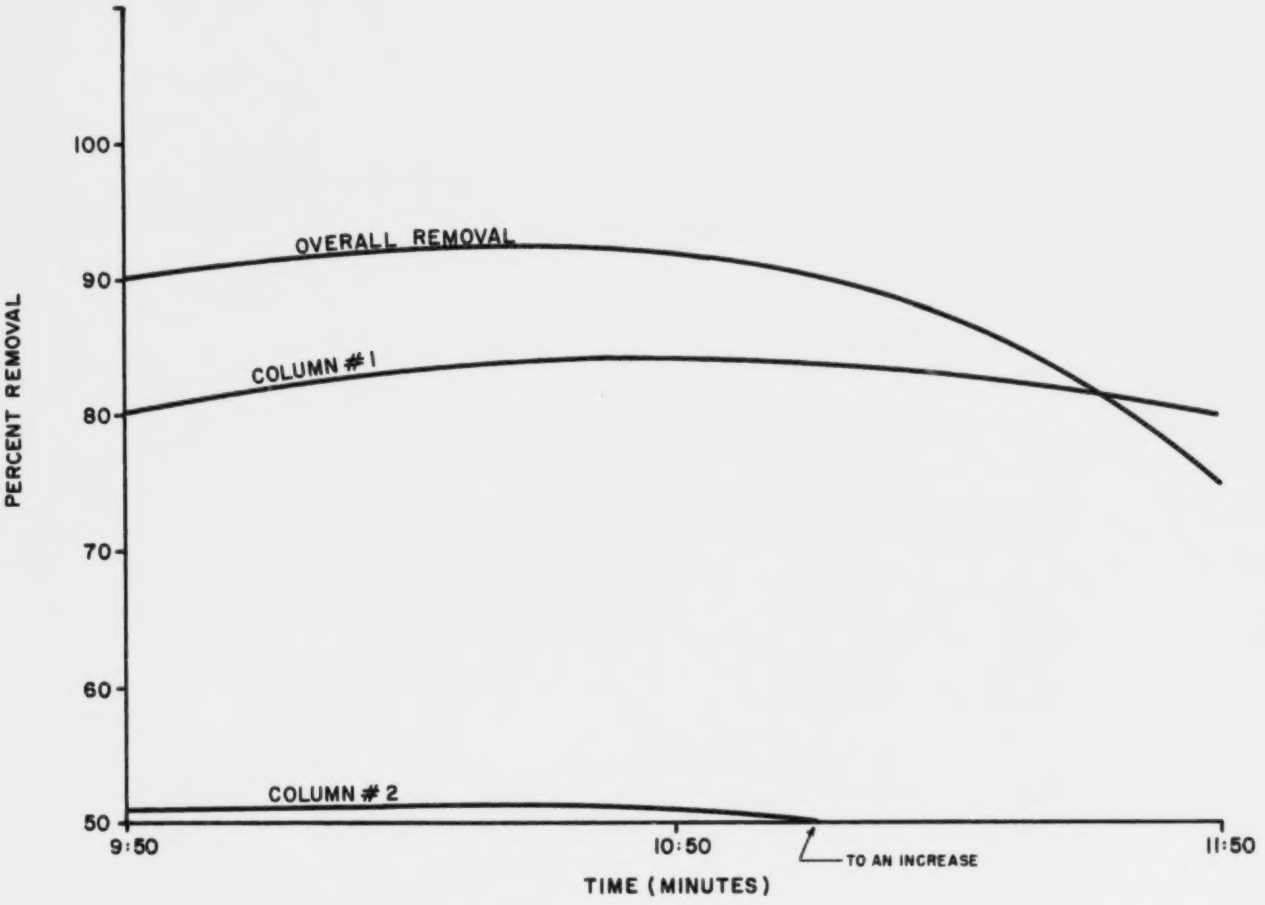
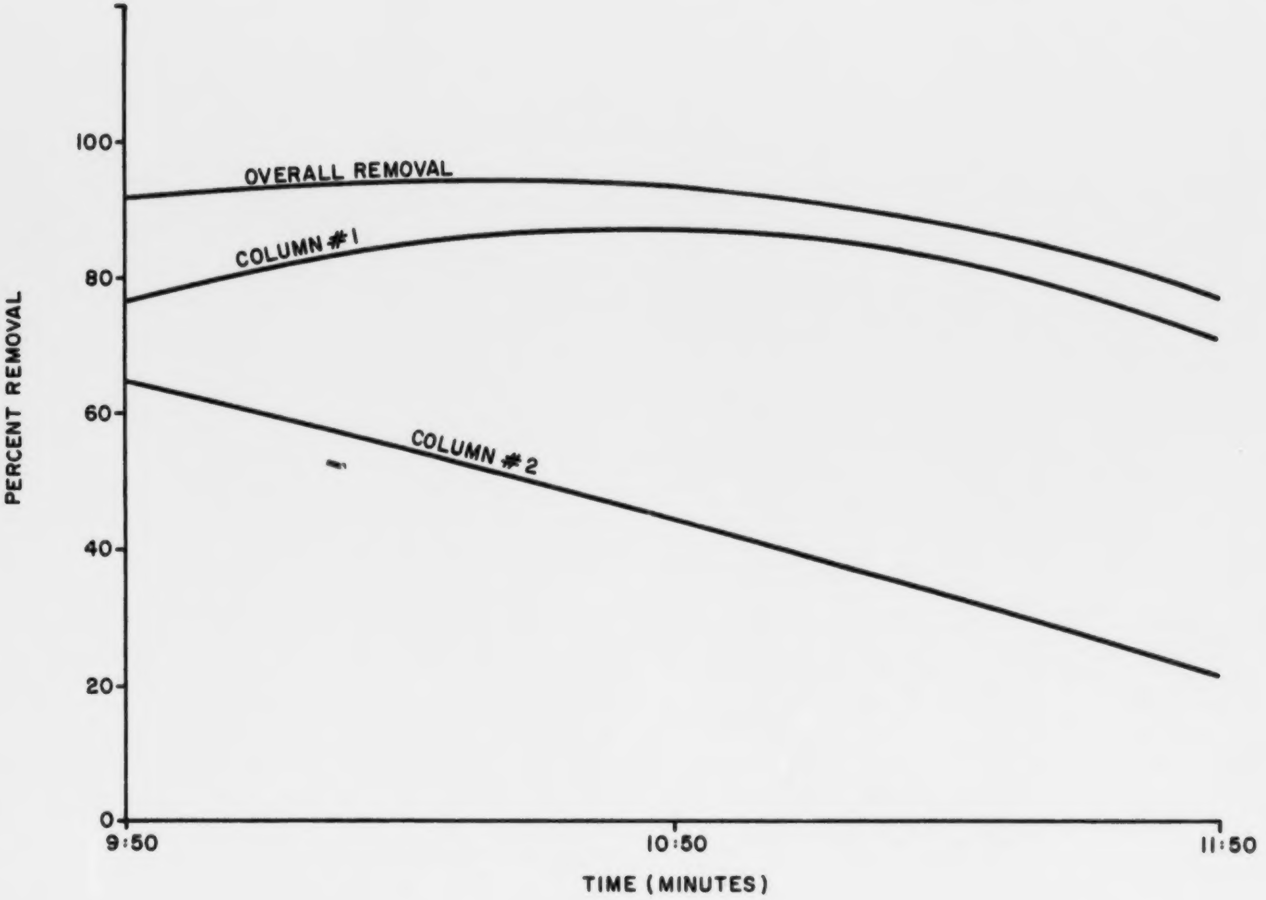


FIGURE 32
PILOT PLANT REMOVALS
TETRACHLOROGUAIACOL PROGRAM #6



SECTION 8

COST ESTIMATE

An estimate of the capital, operation, and maintenance costs can be made using the projected cost of the full-scale plant installation currently underway at Billerud Uddeholm AB. These estimates can be used to project installation costs in United States pulp, paper, and paperboard facilities.

The capital cost includes all costs incurred in construction of this facility (e.g. building, piping, equipment, electrical, HVAC, computer control and pretreatment system). These costs are presented in U.S. dollars in Tables 33 and 34. Billerud Uddeholm AB personnel have estimated that the capital cost of the pretreatment system (included in the capital cost) is $750,000. This cost includes a portion of the building, piping and computer costs which can be related to the pretreatment system. Billerud Uddeholm AB personnel estimate the operation and maintenance cost of this pretreatment system will be about $0.25/ADMT.

The costs presented in Tables 33 and 34 are based on the installation of an ion exchange system at a 100,000 metric ton per year bleach plant. Care must be taken in projecting installation in facilities with bleach plants or production levels different from those at Billerud Uddeholm AB. These costs represent those incurred in constructing this facility in Sweden. Costs in the U.S. may differ for many reasons.

TABLE 33

Current U.S. Costs Associated with Ion Exchange Treatment

Component	Cost Range[1]	Average Cost	Unit Cost
NaOH	\$140-\$175/ton	\$157.5/ton	\$0.0788/lb.
H_2SO_4	\$30-\$65/ton	\$52/ton	\$0.026/lb.
Na_2SO_4	\$45-\$52/ton	\$48.5/ton	\$0.0243/lb.
Resin[2]	$\$145\text{-}\$185/\text{ft}^3$	$\$165/\text{ft}^3$	$\$165/\text{ft}^3$
Steam[3]			\$0.0048/lb.
Electricity[4]			\$0.0325/KWH

Note:

1 - Source: Chemical Marketing Reporter, February 4, 1980

2 - at 25 lb./ft^3 (dry basis)

3 - 80% boiler efficiency, 6.3×10^9 BTU's/Barrel of oil at \$24/barrel, 1000# of steam/million BTU's

4 - Reference 5

TABLE 34

U.S. Equivalent Operating Costs for the Full-Scale Billerud Uddeholm AB Plant

Component	Kappa 18		Kappa 35	
	lb./ton	$/ton	lb./ton	$/ton
NaOH	17.3	1.36	32.7	2.58
H_2SO_4	17.3	0.45	22.98	0.60
Na_2SO_4	-16.0	-0.39	-30.0	-0.73
Resin(ft^3/ton)	0.0045-0.006	0.74-0.99	0.009-0.0119	1.49-1.96
Steam	0	0	-18.14	-0.09
Electricity (KWH/ton)	18.14	0.59	24.49	0.80
Total Operating Cost $/ton		2.75-3.00		4.65-5.12
Total Operating Cost with 110,253 tons/year[1]		303,000-331,000		513,000-564,500
Maintenance (direct conversion)		54,000		83,000
Labor[2]		51,000		51,000
Capital Cost (10% interest at 10 year investment)		478,000		478,000
Total		$886,000-914,000		$1,125,000-1,176,500

Notes:

1 - These costs are scaled from the projected Billerud costs at a production of 100,000 metric tons/year = 110,253 tons/year.

2 - $35,000 - $40,000/year, average = $37,500 + 35% labor cost.

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1. "Development Document for Effluent Limitations Guidelines and Standards for the Pulp, Paper, and Paperboard and the Builders' Paper and Board Mills - Point Source Categories - Proposed," EPA 440/1-80/025-6, 1980.

2. "Sampling and Analysis procedures for screening of industrial effluents for priority pollutants," U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio, March 1977, revised April 1977.

3. Personal Communication with Sigvard Lindberg of Billerud Uddeholm AB, Skoghall, Sweden, Telex, January 12, 1981.

4. "Sampling and Analysis of Priority Pollutants from a Swedish Pulp Mill Effluent Treated by Ion Exchange Columns - Final Report," Radian Corporation, May 1980, included as Appendix B.

5. "The Record for Establishment of BCT, BAT, NSPS, PSES, and PSNS for the Pulp, Paper, and Paperboard industrial point source category," Data Generation, Volume III of Technical Data Generation, Non-confidential, pp. 189.

6. Lindberg, S., and L.B. Lund. A "nonpolluting" bleach plant. Tappi, Vol. 63, No. 3, March 1980.

APPENDIX A

SORPTION —— ION EXCHANGE

A BRIEF OVERVIEW

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DIAMOND SHAMROCK
REDWOOD CITY, CALIFORNIA

Sorption[1] and ion exchange are processes in which a component is transferred from solution to a solid phase. Usually the material to be transferred is relatively low in concentration. The solution is put in contact with a solid and the component is concentrated in or on the solid phase. In commercial practice this is usually done by passing the solution through a bed or column of granular solid.

Sorption and ion exchange are carried out in similar equipment. Many basic engineering concepts apply to both, such as counter-current contacting, column behavior, and interphase material transport. However, the chemistry of sorption and the chemistry of ion exchange are different. Further, there are many systems which have elements of both. The wide range of this general type of process has great potential for removal of obnoxious materials from process and waste streams.

SORPTION

Sorption is the transfer of a component from solution to, and concentration on, a solid. There is no coupled transfer of a component in the opposite direction. The source of the affinity between the sorbed component and the solid often is not well defined. The sorbed component may interact with the internal surface of the solid phase, or merely concentrate in liquid held in the solid phase.

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[1] The general term "sorption" is used as there is no need to distinguish between adsorption and absorption.

The solid may be carbon, an inorganic mineral, a modified cellulose, an organic polymer, or any number of other materials. The interaction between solution components and substrate may be $\Pi - \Pi$ attraction, weak complex formation, preferential solubility, electrostatic interaction, etc. Because of the wide variety of mechanisms possible, component-substrate binding varies from extremely weak to very strong. For a given component-substrate pair the strength of binding may vary with such system condtions as temperature, pH, nature of solvent, etc.

The effectiveness of a given sorbent for removing a given component is usually determined empirically. The sorbent and a solution of the component are mixed in varying ratios. After the mixture has equilibrated, the solution is analyzed for component remaining. The data is plotted on log-log paper as weight of component removed from solution per weight of sorbent versus concentration of component remaining in solution. The data usually plot as a straight line, termed a sorption isotherm. Two properties determine the isotherm: (a) the maximum amount of component the sorbate can hold, and (b) the strength with which the component binds to the sorbate. The higher the loading the higher the isotherm will be above the X axis. The stronger the binding the more nearly horizontal the isotherm will be.

The performance of a sorbent in a column can be predicted from this isotherm. In general, the more horizontal the isotherm, the more solution that can be treated before the component appears in the effluent. The amount of component that can be loaded on the column is dependent on the concentration in the feed to the column, particularly when the isotherm has a high slope.

While a strong interaction between component and substrate is desirable for good loading, it may present problems in removing the sorbed material. In most cases the process must be cyclic, incorporating a desorption step. Exceptions to this occur when the economics allow for sacrificing the sorbent, as in precious metal recovery.

Desorption depends on finding a set of conditions under which the sorption isotherm is markedly lowered. This may be a change in solvent, pH, temperature or oxidative state. Concentration of components on carbon is often followed by controlled combustion which reactivates the carbon. Other common desorbents are organic solvents, acids and bases.

Examples of commercial sorption processes include:

(a) Removal of color bodies from concentrated sugar solutions using bone char. The bone char is regenerated in kilns.

(b) Concentration of gold from dilute cyanide leach solution by sorption on activated carbon. The gold is stripped with a mixture of sodium hydroxide and sodium cyanide and the carbon is reactivated thermally.

(c) Removal of phenolics from waste streams by sorption on highly porous aromatic polymers. The phenols are stripped with organic solvents.

(d) Removal of water from organic liquids by sorption on activated alumina. Alumina is reactivated thermally.

ION EXCHANGE

Ion exchange is the transfer of ions from solution to solid with the simultaneous transfer of ions of equal charge from solid to solution. The solid, an ion-exchange resin, has a fixed number of ionic sites per unit volume which are filled with ions at all times. The composition of the ions in the resin results from chemical equilibrium between resin and solution. Therefore, the ionic composition of the resin is determined by the ionic composition of the solution and the relative affinities the resin shows for these ions.

Synthetic ion-exchange resins are organic polymers to which have been added ionic groups. The majority of commercial ion-exchange resins are based on copolymers of styrene and divinylbenzene. Other polymer bases include phenol-formaldehyde condensates, epoxy-polyamine condensates and polyacrylates.

The standard cation exchange resin is prepared by polymerizing styrene and divinylbenzene to give a highly cross-linked plastic bead which is then reacted with concentrated sulfuric acid. Sulfonic acid groups are attached permanently to the aromatic rings. The sulfonic groups are balanced by cations of equal total charge. These cations are subject to exchange with cations from solution.

Similarly, anion exchange resins are prepared by attaching quaternary-ammonium groups to the polymer. These resins have the ability to exchange anions.

Strong-acid cation-exchange resins (sulfuric acid functionality) and strong-base anion-exchange resins (quaternary ammonium functionality) are fully ionized and have constant ion-exchange capacities over the entire pH range.

With the strong-acid cation and strong-base anion-exchange resins the relative affinities between inorganic ions is nominal. None of these resins is specific for a given ion, but rather they are selective for ions or groups of ions. In some cases this selectivity is dependent on total ionic concentration in solution. The performance of these resins with a given solution usually can be estimated by chemical equilibria calculations from known resin properties and solution compositions.

Ion exchange resins have a capacity fixed by the total number of exchange sites per unit volume. With strong-acid cation-exchange resins the total capacity is about 2 equivalents per liter. With strong-base anion-exchange resins the total capacity is roughly 1.3 equivalents per liter. When the total capacity has been exchanged for ions from the incoming solution, the resin is said to be exhausted. The flow to the column is stopped and the resin is regenerated.

Regeneration is carried out by passing a fairly concentrated solution containing the desired ion through the column. The resin is converted back to the original ionic form, and another exhaustion cycle can be run. The amount of regenerant required to displace the ions on the resin varies from stoichiometric to several times stoichiometric. The efficiency depends on the relative affinity the resin shows for the two ions under the conditions of regeneration.

Examples of commercial processes with strong-acid or strong-base exchangers include:

(a) Softening of water using a strong-acid cation exchange resin in the sodium ion form. Hardness ions, predominately Ca^{++} and Mg^{++}, are exchanged for Na^{+}.

$$CaCl_2 + 2\ NaSO_3R^* \rightarrow Ca(SO_3R)_2 + 2\ NaCl$$

Regeneration is carried out with a 5-15% solution of sodium chloride, the reverse of the above reaction.

(b) Water can be deionized completely by using a combination of strong-acid resin in the hydrogen ion form and strong-base resin in the hydroxide ion form.

$$NaCl + HSO_3R \rightarrow NaSO_3R + HCl$$

$$HCl + RNMe_3{}^{**}\ OH \rightarrow RNMe_3Cl + H_2O$$

The cation exchange resin is regenerated with hydrochloric or sulfuric acid and the anion-exchange resin is regenerated with sodium hydroxide.

(c) Uranium is concentrated from dilute solution by exchange of the uranyl sulfate complex anion on a strong base resin. The uranium is eluted to give a concentrated and purified process stream that can be precipitated directly.

INTERMEDIATE BEHAVIOR

Resins containing carboxylic or amine functionality show both sorptive and ion-exchange behavior. These resins, known as weak-acid and weak-base resins, are ionized over only part of the pH range. A resin with carboxylic functionality is essentially non-ionized in solutions below pH 5. Therefore, it shows true ion-exchange behavior only above pH 5. Conversely, a resin containing weak-base functionality, shows true ion exchange behavior only below pH 8.

The principal use for these resins is for removal of acidity or alkalinity from solution. The reaction of a weak-base resin with hydrochloric acid has many of the characteristics of a sorptive process. The loading is concentration dependent and can be represented as an isotherm. However, the mechanism of column operation is but understood as an ion-exchange reaction.

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* R is used to designate the organic polymer in the resin.

**Me denotes a methyl group - CH_3

Actually many sorbents have some ion exchange characteristics and all ion exchangers have sorptive characteristics. Activated carbon contains a wide variety of functional groups which can show ion exchange activity, especially at high pH. The classic color sorbent, bone char, gives some removal of inorganic solutes due to ion-exchange properties of phosphate groups present.

All organic ion-exchange resins are water-swollen gels. The existence of an immobilized liquid in the resin allows a distribution of solutes between solution and solid. Since the liquid inside the resin has different properties from that outside, resins often show strong sorption of particular components. For example, strong-base anion resins show high sorptive capacities for phenols, humic acids and sulfonated aromatic compounds. In fact, in some cases the materials are so strongly sorbed that it is very difficult to strip them from the resin.

The use of ion-exchange resins as sorbents greatly extends the range of possible applications. While the problem of matching the proper sorbent with a particular material to be removed from solution is still empirical, one generalization can be made. As with solubilities, like tends to sorb like. That is, non-polar solutes are more likely to be sorbed from water by non-polar sorbents. Chlorinated hydrocarbons will be picked up better by a porous aromatic polymer than by an ionized resin. Lignin color bodies, which are highly polar, will be picked up preferentially on a sorbent with a more polar character.

An important factor with ion-exchange resins, and particularly with the weakly ionized resins, is that their degree of internal polarity can be switched by converting them from weakly ionized to highly ionized forms and vice versa. This can be critical in developing a successful application.

Sorption processes usually must be cyclic to be economically practical. That is, both loading and stripping must be efficient. Efficient loading requires a high isotherm. Efficient stripping requires a low isotherm. A successful process depends on being able to switch isotherms by altering column conditions.

When sorbing non-polar material, i.e., chlorinated hydrocarbons, on a porous aromatic polymer, efficient stripping is obtained by using a nonpolar solvent. When sorbing a highly polar material on a fully ionized resin, i.e., humic acids on strong-base anion-exchange resins, the material may be desorbed using alkaline brine. This converts the sorbed material to an ionized form which can then be displaced by the high ionic concentration of the brine.

The weakly-ionized resins are particularly interesting in this respect. The interior of the resin can be changed from a high polarity to a low polarity efficiently with acid or base. Thus sorption and stripping can both be done with high efficiency. In addition, the weakly-ionized ion-exchange capacity of the resin serves to buffer the interior of the sorbent and maintain the desired conditions for sorption. This behavior is used in the sorption of lignin colorants into a phenol-formaldehyde resin with weak-base capacity. When the resin is put in a highly ionized form by activation with acid, the lignins are taken into the low pH solution phase inside the resin. Once the resin is loaded, it is stripped with a solution of sodium hydroxide, which converts the resin to a non-ionized form and forces the lignin components out. The lignin colorants are probably not actually ion-exchanged onto the resin. However, the ion-exchange capability of the resin affords good reversibility for the sorption process.

In summary, the solid phases in colum processes may be ranked in regard to polarity.

nonpolar	porous aromatic polymers
↓	alumina
↓	activated carbon
increasing polarity	phenol-formaldehyde polymers
↓	functionalized P.F. polymers
fully ionized	strong-acid, strong-base ion-exchange resins

Those materials having weakly-ionized ion-exchange capacity are of particular interest in sorption processes in that their degree of internal polarity can be controlled.

APPENDIX B

LITERATURE REVIEW

INTRODUCTION

Ion exchange is a technology which has found use in operations such as purifying drinking water, concentrating dilute mineral streams, and removing contaminants from production lines. Ion exchange has been shown to be an economic alternative to other conventional processes. This review was undertaken to determine whether this technology can reduce the discharge of color and toxic materials in the pulp, paper, and paperboard industry.

It has been asked whether this system can be used in the pulp, paper, and paperboard industry without creating internal problems in the recovery and pulping systems. Extensive research in this area is presently being conducted. A number of system designs and adsorbent resins/ion exchange resins have been tested on a laboratory scale, and some pilot plants are in operation. These systems are described in the literature. This appendix will summarize this literature, and present the positive and negative aspects of this treatment alternative as it relates to the pulp, paper, and paperboard industry.

WASTE SOURCES

An analysis of the various wastestreams that make up the discharge from a pulp and paper mill complex indicates that a set of discharges (e.g., caustic and chlorination extracts from the bleaching operation; black liquor spills due to upsets; and decker effluents) contribute major portions of the color and toxic waste loads to the final effluent (1,2). The first caustic extraction stage may contain as much as 95 percent of the color, 70 percent of the chemical oxygen demand (COD), and 50 percent of the biochemical oxygen demand (BOD) in the combined bleach plant effluent (3). If these wastestreams could be eliminated through treatment and recycling operations, a majority of these pollutants would be eliminated from the total waste discharge of pulp and paper mill complexes.

SYSTEM DESIGNS

Pretreatment

Research in ion exchange treatment for color and toxicity removal in pulp and paper wastes reveals that pretreatment is necessary to make the wastewater amenable to treatment. Pretreatment removes particulate material and macromolecules that can irreversibly plug or "foul" the ion exchange resin (4). Various pretreatment modes have been tested on a laboratory and pilot plant scale, including sand filtration followed by charcoal bed filtration (1,5); massive lime precipitation (6); massive lime precipitation with two-stage recarbonation to pH 7.6 (7); adsorption resin treatment (Amberlite XAD-8) (4,7); and pH adjustment to less than 3.0. These pretreatment steps have been tested for specific wastewater/resin combinations resulting in varying finished water characteristics (e.g., pH 7.6 and pH 3.0). All of these treatments perform the same basic function, that is, they essentially remove both both inorganic and organic solids.

At the Billerud Uddeholm AB mill in Skoghall, Sweden the pretreatment system consists of 200 mesh strainers, one on the first extraction stage washer effluent operating at 10 M^3/ADMT, and one on the chlorination stage washer effluent operating at 40 M^3/ADMT. These strainers are followed by mixed media filtration, two on the extraction stage and three on the chlorination stage.

Reactivation

The reactivation system must be optimized to maximize resin utilization. This optimization procedure must consider the resin being used, as well as the mill's pulping, washing, evaporation, and recovery systems. Ion exchange treatment can be more economical if existing caustic streams can be used to elute the ion exchange resin. Various mill flows (weak wash, white liquor and caustic extract) have been tested for this purpose with results reported in the literature (1,2,6,8,9,10). Some resins are not resistant to oxidation and must be protected by use of an eluate with a low oxidation potential. Other resins may require acid activation after alkaline elution, which for some systems may be accomplished by using low pH process solutions (chlorination extract)(1). Part of the elution effluent may be recovered and reused if it is high in residual alkali (i.e., if pH is greater than 11.0). An alkaline re-use process will minimize waste discharges from the ion exchange treatment by concentrating the pollutants (2). An example of a reactivation system is air scouring to loosen particulate or fibrous materials; backwash to wash these materials from the column; removal of the color bodies and other pollutants with alkaline eluate; washing to clean the resin of alkaline eluate; and, if necessary, activation with acid (chlorination extract or other chemicals).

The literature reports that resins have been used for 3 to 12 months without substantial loss of capacity. These studies used different resin types, elution/ activation chemicals, and were used for removal of different waste components (e.g., decolorization versus deionization). Billerud

Uddeholm AB has successfully used the Diamond Shamrock resin developed for this application without appreciable oxidation or damage for 14 months (and postulates potential life at 18-24 months with complete optimization of the treatment system). This time period may be lengthened through system optimization considering colder operation temperatures, eluates with a reduced oxidizing potential, treatment of the feed with sulfur dioxide or sodium hydrosulfite, or using oxidant resistant resins (7).

The reactivation system used at the Billerud Uddeholm AB facility consists of a sodium hydroxide solution for pollutant elution followed by activation with chlorination extract.

Disposal

The ability to dispose of the regenerant within the mill complex once it is saturated with color, toxic materials and organic matter can reduce the cost of ion exchange treatment. Research shows that this waste contains materials of organic nature that can be burned, with a net release of heat which then can be used in the mill's power generation plant. At the Billerud Uddeholm AB mill, the regenerant wastestream is added to the black liquor wastestream, which goes to the evaporation system, and then to the chemical recovery boiler where it is burned (4,8). Care must be taken that excessive amounts of potentially corrosive materials (inorganic chlorides) are not passed on to the recovery furnace where corrosion-type failure may result. Research shows that most (90 percent) of the chlorides pass directly through the ion exchange process and are discharged with the treated water (3). The majority of the chlorides that pass on to the recovery system have been found to be organically bound and do not cause corrosion problems in the recovery furnace (11). This small chloride residual that persists is not excessively corrosive (3,12). The chloride level at Billerud Uddeholm AB is maintained at a steady concentration of 2 g/l in the white liquor. Personnel at this plant feel that levels as high as 15 g/l can be tolerated without problems.

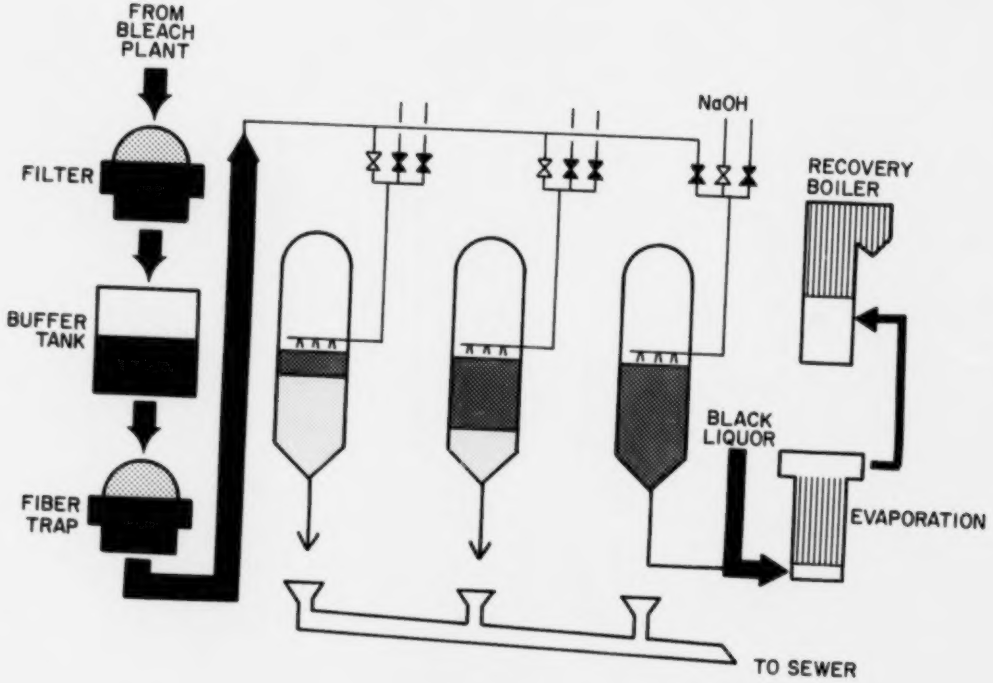
Treatment Flow Schemes

Work has been done to determine optimum resin types and their combinations for treatment of bleach plant wastes (6). The conventional mode is referred to as "fixed bed" treatment, where the resin is in a packed column and the flow is downward through the column. Many modifications of this method are available, from upflow to progressive mode. Reference should be made to the literature for detailed descriptions of each treatment configuration (6,13,14).

Process Flow Schemes

Three basic process flow schemes have been developed for application to bleach plant effluents. These are the Rohm & Haas process, the Dow process, and the Billerud Non-polluting Bleach Plant Concept. Of these, only the Billerud Non-polluting Bleach Plant Concept is currently in full-scale use in a pulp and paper mill (9,15,16). This process (Figure 33) consists of a

FIGURE 33
THE UDDEHOLM – KAMYR CLEARWATER PROCESS


FROM BLEACH PLANT
FILTER
BUFFER TANK
FIBER TRAP
NaOH
RECOVERY BOILER
BLACK LIQUOR
EVAPORATION
TO SEWER

prefiltration step, followed by ion exchange treatment at low pH with macroporous weak-base resin based on a phenol-formaldehyde polymer matrix. Sanks (6,7) found this resin type to be advantageous for bleach plant effluent treatment. It was developed by the Diamond Shamrock Corporation in cooperation with Billerud Uddeholm AB specifically for application at this mill. Once the breakthrough capacity is reached, the resin is eluted with technical grade NaOH. The caustic eluate goes to evaporation with the black liquor, and is finally burned in recovery. The eluted column is then activated using chlorination extract prior to reuse in the next cycle.

In the Rohm and Haas process (Figure 34), the key to operation is the Amberlite XAD-8 adsorption resin (16), which is an adsorption resin and not an ion exchange resin. This process works through a reversible adsorption process as a result of Van der Waals forces (8) and hydrogen bonding rather than a direct exchange of ions. The XAD-8 resin is a highly cross-linked hydrophilic, porous polymer with no ion exchange sites. The process involves resin treatment until breakthrough capacity is reached. At this point, the resin is reactivated using weak wash from the lime mud washing system. The spent eluate is then recycled to the kraft process where it is used to dissolve smelt (the slag resulting from combustion) from the recovery boiler. The color bodies and other organics present are ultimately consumed in the recovery boiler without creating another disposal problem. An increase in evaporation capacity of 1.3 to 5 percent is noted in the literature (16).

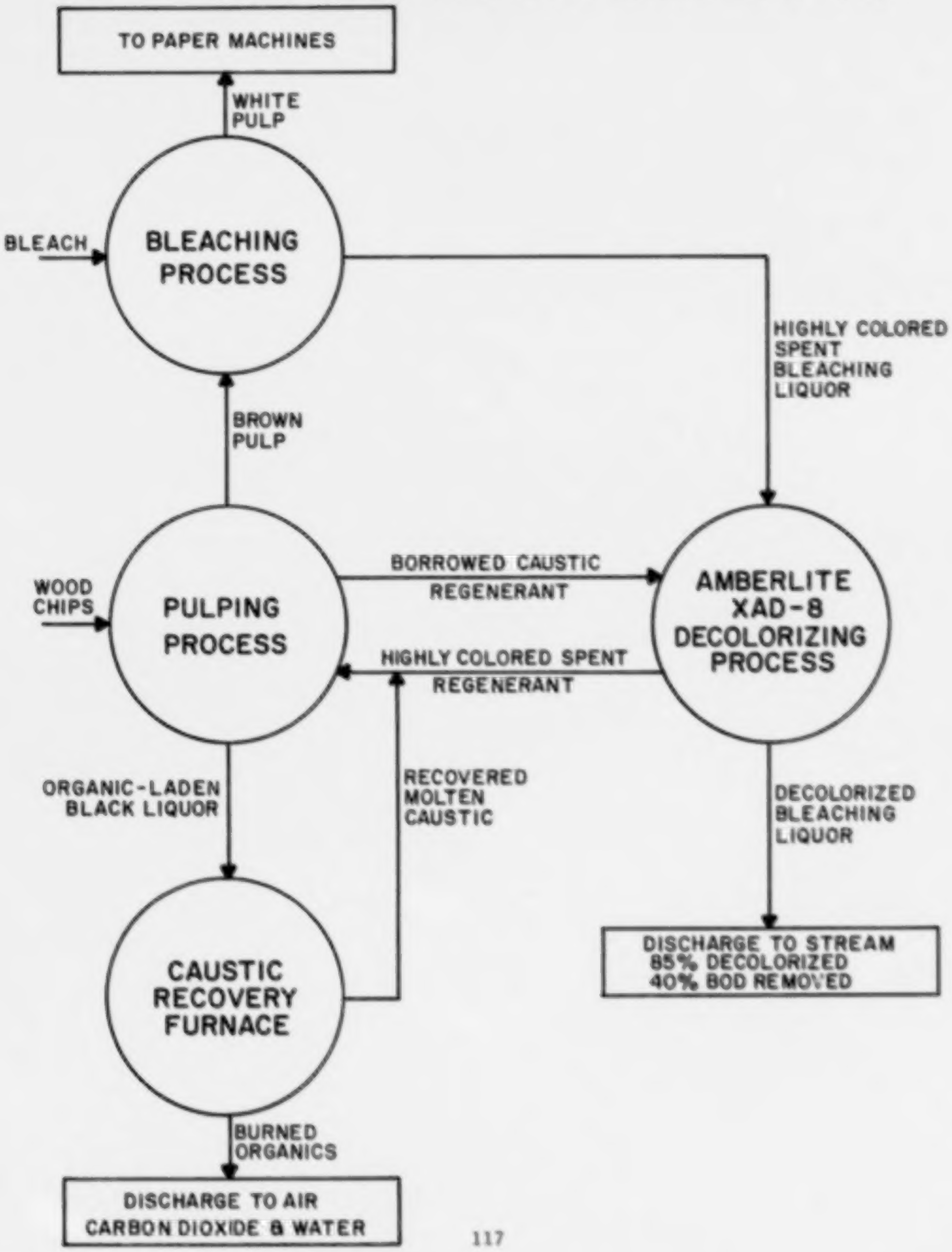
The Dow system makes use of a family of experimental resins being developed for this application (1). The caustic and chlorination extracts are mixed to a pH of 2 to 9. The resulting stream is then passed through sand and charcoal filters, then onto the resin column where it is applied until breakthrough occurs. At this point weak wash is used to regenerate the resin and saved for future regeneration (maintained at pH 11 and reused until saturated). The resin is then activated with chlorination extract that is partially decolorized in the process. This treatment has been tested on a laboratory scale using a number of pulp and paper wastestreams, and has been found effective for all wastes tested. A mini-pilot plant has been operated on a bleached kraft softwood facility with good results showing no noticeable resin oxidation (1).

RESIN TYPE COMPARISON

Research

Research has compared different ion exchange resins and adsorption resins for treatment of a particular wastestream and has shown the advantages and disadvantages of different types and activation forms. Researchers are confident in the practicability of ion exchange/adsorption processes. As noted by Ruzickova, "it can be assumed that by proper selection of the resin it should be possible to treat any wastewater polluted with soluble organics" (4). It may be difficult, however, to find the correct

FIGURE 34
BLEACH PLANT DECOLORIZATION THE ROHM AND HAAS PROCESS (8)



TO PAPER MACHINES
WHITE PULP
BLEACH
BLEACHING PROCESS
HIGHLY COLORED SPENT BLEACHING LIQUOR
BROWN PULP
WOOD CHIPS
PULPING PROCESS
BORROWED CAUSTIC REGENERANT
HIGHLY COLORED SPENT REGENERANT
AMBERLITE XAD-8 DECOLORIZING PROCESS
ORGANIC-LADEN BLACK LIQUOR
RECOVERED MOLTEN CAUSTIC
DECOLORIZED BLEACHING LIQUOR
DISCHARGE TO STREAM 85% DECOLORIZED 40% BOD REMOVED
CAUSTIC RECOVERY FURNACE
BURNED ORGANICS
DISCHARGE TO AIR CARBON DIOXIDE & WATER

resin, as "color-producing organics are complex and attempts to match a resin to a water source are difficult (17)."

Selectivity

Cognizant of these problems, researchers have designed their studies so that broad classes of resins can be recommended or ignored. They have been able to show that for color and toxicity removal weak electrolyte resins with phenolic matrices are superior to strongly basic anion exchangers (6,18). The Billerud Uddeholm AB treatment system makes use of a weak electrolyte resin with a phenol-formaldehyde polymer matrix base. Advantages exist for use of the strong anion exchange resins in some industrial processes. For example, these exchange resins exhibit a selectivity for large organic molecules. This selectivity makes the use of strong electrolyte resins advantageous for removing soluble organic pollutants from production lines (sugar, molasses, etc.). These strong electrolyte resins do not maintain capacity well with cyclic operation and tend to foul severely when used to treat pulp and paper wastestreams.

Another series of resins that works well are those classified as adsorption resins, which work on a reversible adsorption principle rather than an ion exchange principle (17). The adsorbents range from hydrophobic (water-hating) to be hydrophilic (water-loving) (17). Of these adsorbents, the hydrophilic Amberlite XAD-8 has proved to be one of the most resistant to destruction by oxidizing-type regenerants (7).

Resin Oxidation

Resins resistant to oxidation exhibit a capacity at breakthrough that is much less than their oxidizable counterparts (19). This points to an economic trade-off between high capacity and durability. If resins were relatively inexpensive, the higher capacity resins would be a more economically attractive alternative. Regenerant chemical use would be reduced and the subsequent concentrated wastestream would be much smaller. If resins are an expensive item, however, the durable resins become more economical, and inexpensive methods of regeneration and treatment of the spent regenerant must be found. The aforementioned processes (the Billerud Non-polluting Bleach Plant Concept, the Rohm & Hass process, and the Dow process) make use of low capacity oxidation-resistant resins to overcome this problem.

VARIABLES AFFECTING TREATMENT

Measurement of Color

In an effort to effect better removal of colored materials from wastestreams, attempts have been made to determine the constituents making up color bodies, and the expected changes in these bodies with environmental changes. Some researchers believe that natural color is caused by a light-scattering tendency rather than a molecular adsorption (17). Color bodies exhibit acidic properties and react to changes in solution pH as follows: as the basic pH region is approached, the color increases; as an acid pH is approached, the color decreases in a non-linear fashion (17). Since the color changes with pH, it is necessary to establish standard conditions to compare color values. For the pulp, paper, and paperboard industry, these conditions have been proposed to be pH 7.6 and analysis at 465 nanometers (20).

Variables Affecting Color Removal

Color removal using ion exchange or adsorption resins is a function of residence time, total volume processed, temperature and pH. Overall color removal is more effective at a low pH, when employing a weak base resin (1). As the pH of the solution decreases, the organic adsorption, as well as breakthrough capacity, increases (10,17). Optimum pH for color removal is postulated to be approximately 2.5 (2). Changes in operation as the temperature fluctuates are not as dynamic as changes when pH fluctuates. Color removal can be increased as temperature increases to a point, then the removal can decrease, remain the same, or even increase at a different rate as the temperature continues to increase (1,6). Color removals tend to increase as the residence time is increased, and decrease as the throughput volume increases to the breakthrough point (1).

Variables Affecting Removal of Lignins & Other Organics

Differences in temperature can cause different rates of adsorption and desorption for organic materials (4). At 20°C organic matter (measured by COD) is adsorbed at a slower rate than lignins, yet is desorbed at the same rapid rate. At 70°C organic matter and lignins are adsorbed at the same rate as at 20°C, yet the organics are slower to desorb.

Sulfite/Sulfate Mill Treatment

Research reveals that adsorption resins treat sulfite pulp mill wastes quite well, while a mechanico-biological treatment (chemical coagulation followed by biological treatment) may be necessary prior to adsorption resin treatment for sulfate mills (4). Research with wastes from a sulfite operation (hardwood) has shown that adsorption resin treatment of the waste reduces the COD to a larger degree than the color of the waste.

Particle Size & Temperature Affects

Resin particle size affects both exchange and adsorption processes. Breakthrough capacities increase with decreasing particle size, but the system's head loss increases. Temperature increases also tend to decrease the system's head loss and breakthrough rate, and increase the breakthrough capacity (17).

Large Organics

The macromolecular material or large organic molecules have caused problems in the exchange and adsorption systems. These wastewater components either do not bind at all (10) or bind irreversibly so that the columns foul (17), indicating a need for pretreatment before ion exchange or adsorption treatment. This eliminates the possibility of resin deterioration.

REMOVAL EFFICIENCIES AND CAPACITIES

Removal efficiencies and resin capacities usually are parameters identified when research is done to test the practicability of this treatment technique. Care must be taken in reviewing this data, as study results are not necessarily applicable to other facilities (7). An in-depth review of the research and analysis phase of each is a must to gain insight into the applicability of a treatment scheme to a particular pulp and paper facility. The literature reviewed in this study reports varying capacities and treatment efficiencies for the different systems. Table 35 outlines the different values reported in the literature. Reference should be made to the articles for a better understanding of the removals applicable to a given system (1,2,3,5,8,16,19,21,22,23).

TABLE 35. RESIN CAPACITIES AND REMOVAL EFFICIENCIES

Capacity, kg platinum units/m^3 of resin	250 to 270
Color, % reduction	70 to 95
BOD, % reduction	26 to 60
COD, % reduction	43 to 90
Aromatics, % reduction*	81
Toxicity, % reduction	63 to 100
TOC, % reduction	43
TDS, % reduction	89
Chloride, % increase	39

*As measured by adsorption at 280 nm (1).

The referenced material presents extensive graphic representations of the analyses, which may aid in understanding the chemical balances involved in this treatment (3,5). It is evident in Table 35 that ion exchange resins have a greater affinity for color than for organic matter, as measured by BOD or COD (17). Researchers (22) have found that the capacity for chlorocompounds remains, even when the resin capacity is reduced toward breakthrough such that potentially toxic or harmful wastes are effectively removed throughout the treatment cycle.

TOXIC AND HAZARDOUS WASTE REMOVAL

Public concern for reduction of toxic waste discharges has led to research on removal techniques. Resin research indicates that the ion exchange treatment can remove substantial portions of this waste. Some researchers have shown toxicity to be removed at the same rate, or slightly lower, than color (1,19). Other researchers have found the treated effluent to be nontoxic at 100-percent concentration (2).

One researcher (24) has tested the removal of specific phenolic compounds on polymeric adsorbents. This researcher determined the effectiveness of removal of phenol; 3-chlorophenol; 2,4-dichlorophenol; and 2,4,6-trichlorophenol, all at a concentration of 2.7 moles/l at a flow rate of 0.5 gpm/ft^3 of resin. He found that the resin exhibited the following capacities without leakage: 0.78; 2.4; 5.09; and 12.02 lbs/ft^3 of resin, respectively. Kamyr Inc. has also pointed out significant reductions in mutagenic compounds with this technique (19). No other treatment has demonstrated the ability to remove and concentrate very small amounts of materials from a wastestream.

ADVANTAGES & DISADVANTAGES

Treatment of pulp mill wastestreams using ion exchange or adsorption resins has distinct advantages, which can be summarized as follows (2,4,9):

- removes color-producing substances;
- detoxifies effluents and removes most mutagenicity;
- reduces BOD and COD;
- removes humic materials;
- conserves energy;
- expels the majority of chlorides;
- no sludge generated, i.e., no dewatering or disposal necessary;
- eliminates chlorinated phenols and guaiacols;
- treatment outside production line (no influence on pulp quality);
- capacity can be reactivated;
- removes biologically resistant substances (e.g., detergent builders); and
- the colored effluent can be concentrated to two percent of the original flow.

The large-scale pilot plant operation at Billerud Uddeholm AB has demonstrated that ion exchange can be used to treat pulp mill wastestreams for reuse economically (9). This operation has resulted in neither a discernable change in pulp quality, or an increased chemical use.

Research in the use of ion exchange/adsorption resins also reveals some disadvantages, summarized as follows (10,16,17,23,25).

- resin oxidation during reactivation;
- resin fouling, and lack of reactivation methods of fouled resins;
- optimization of eluate/activant use;
- short resin life;
- integration with mill processes;
- low pH necessary;
- potential for chloride buildup;
- installation costs can be 50 to 100 times biological treatment;
- large molecular weight fractions are not removed by ion exchange; and
- increased evaporation and recovery capacity may be necessary.

Whether ion exchange/adsorption resin treatment is an economical treatment alternative for a pulp mill complex depends upon several variables. A decision can only be made after operating a pilot plant with attempts to maximize performance at minimum cost.

Extensive research was undertaken by Sanks (6) in the early 1970's to assess the use of an ion exchange technology as a treatment technique in closing up kraft bleach plants. In his report Sanks itemizes eight most pressing problems requiring further research:

- reduction or elimination of the aggressiveness of the wastes;
- integration of regenerating chemicals into the mill process;
- inexpensive recovery or disposal of concentrated wastes from the ion exchange plant;
- development of new resins more resistant to attack;
- optimization in the selection and operation of necessary pretreatment methods;
- optimization of ion exchange with respect to selection of system and its operation;
- careful consideration for the integration of other processes including reverse osmosis, carbon sorption, and the use of newly-developed ion exchange processes for pretreatment; and
- elimination of slime, foaming, and corrosion problems.

Billerud Uddeholm AB, in conjunction with the Diamond Shamrock Corporation, have eliminated or minimized these problems in the Non-polluting Bleach Plant Concept. Specifically, these problems were addressed as follows:

1. The aggressiveness of the waste has not been reduced but the materials of construction used are very resistant to attack (stainless steel and fiber reinforced plastic). Oxidants (free chlorine) are eliminated from the wastestreams prior to ion exchange treatment to minimize the potential for resin oxidation.

2. The elution chemicals used (NaOH) serve as a source of cooking liquor chemical makeup and are thus integrated into the system. The activant used (chlorination stage effluent) is a wastestream and is cleaned during the reactivation step, thus integrating this into the process.

3. The eluted wastes are evaporated and burned in the recovery system, thereby integrating a cost-effective waste disposal scheme into this treatment step.

4. With the aid of the Diamond Shamrock Corporation, a resistant resin has been developed.

5. Screening and mixed media filtration has proved an effective pretreatment operation.

6. Seven years of batch and pilot plant system operation have developed an optimal treatment configuration.

7. The pretreatment system, outlined in 5 above, has proved effective in this operation, eliminating the need to consider other pretreatment technologies.

8. Sliming is not a problem if manufacturer's recommendations are followed. Foaming can be a problem but if air is eliminated from the system, the foam generation is eliminated.

In conclusion, the solution to these and other unique problems is research at the site. Billerud Uddeholm AB researched their system for seven years prior to designing a full-scale scheme.

COMPARISON WITH OTHER TECHNOLOGIES

The economics of a treatment scheme is of paramount importance to a waste generator. To aid in gauging the economics of different treatment options, researchers have compared these treatment types for different wastestreams. One researcher noted that "...no water treatment system exists that removes ions from water so fast, so completely, or at so low a pressure drop [as ion exchange]" (26). Another study compared ion exchange to flocculation and precipitation, activated carbon, and aerated lagoon treatment for color and toxicity removal. These latter technologies were found technically and/or economically unacceptable for the following reasons:

- the sludge generated by flocculation/precipitation treatment is very low in solids, is sticky, and filters extremely slowly;
- the aerated lagoon technique removes color poorly; and
- activated carbon treatment can involve a troublesome thermal regeneration step with a substantial loss in capacity, and can prove to be an expensive treatment alternative (3).

A comparison of activated carbon treatment and ion exchange treatment shows that though carbon treatment may exhibit better organic removals, the ion exchange resins exhibit better removals of color and toxicity (10,25). This indicates that for maximum pollutant removal, a two-component system (ion exchange/activated carbon) may be used.

One researcher noted that weak-base anion exchange resins exhibit a greater capacity than activated carbon for non-biodegradable detergent builders (27). Ion exchange has also been found closely competitive with reverse osmosis for demineralization operations (6). Carbon treated water was used as feed to reverse osmosis, electrodialysis and ion exchange in one study, and primary and secondary ion exchange were found to be the most promising treatment in this demineralization plant (21).

These studies show that ion exchange treatment must be considered as a treatment alternative. Though it may not be the most economical choice for some mills, the noted performance standards indicate that it can be a very viable option for many facilities.

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APPENDIX C

Contract 219-043
DCN 80-219-043-01

SAMPLING AND ANALYSIS OF PRIORITY POLLUTANTS FROM A SWEDISH PULP MILL EFFLUENT TREATED BY ION EXCHANGE COLUMNS

FINAL REPORT

13 May 1980

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1.0 INTRODUCTION

Patented Swedish technology at the Billerud-Uddeholm AB kraft pulp bleach mill in Skoghall, Sweden, has potential for providing cost-effective innovative technology that could be applicable to similar mills in the United States. Preliminary information supplied to Radian indicated certain of the U.S. EPA's Priority Pollutants were being effectively removed with this new technology. Therefore, Radian Corporation, as a subcontractor to the E.C. Jordan Company and the U.S. Environmental Protection Agency, developed an intensive sampling and analysis program in conjunction with the E.C. Jordan Company to provide preliminary data on the effectiveness of removal of such Priority Pollutants plus specially selected fatty and resin acids and phenolic compounds from the wastewater effluents of the Skoghall mill.

Because of complex international shipping regulations it was determined from the beginning that the only practical way of obtaining reliable organic samples was to do on-site extractions in Sweden. Consequently, Radian provided a chemist experienced in both sampling and analytical protocols for EPA's Priority Pollutants to accompany the E.C. Jordan's team of engineers to the Skoghall mill. Necessary solvents and equipment were obtained in Sweden with the help of representatives from the Skoghall mill and of the Swedish Forest Products Research Institute.

The sampling and analyses were conducted in two phases. Chemists at the Skoghall mill shipped three samples to Radian for an initial "Screening Phase" analysis. These samples were analyzed to determine if any unusual Priority Pollutants were present and to provide data for estimating the levels at which internal standards should be spiked into the aqueous samples prior to extraction.

The second "Technology Assessment Phase" consumed the bulk of the analytical effort. Samples from the full-scale batch resin treatment system and from the pilot plant new resin treatment system were taken, processed on-site and shipped to Radian for analysis. Small aqueous samples for the purge and trap analyses and for trace element analyses were also shipped to Radian. Concurrent with the sampling and analysis effort was a comprehensive quality assurance program.

These efforts and the resulting analytical data are presented in the following sections. Section 2 details the sampling episodes and descriptions of the sampling points and the samples. Section 3 describes the preparations required for the organic and inorganic samples prior to analyses. The GC-MS analyses are described in detail in Section 4 and the trace element analyses are presented in Section 5. Finally, the quality assurance program with the various quality control data are provided in Section 6.

2.0 SAMPLING

During February and March, 1980, an intensive sampling program was conducted at the Billerud-Uddeholm AB bleach plant in Skoghall, Sweden.

Two distinct sampling efforts were conducted during this program. During the first phase three grab samples were collected by plant personnel to provide background information. These samples were collected on 15 February 1980. On 25 February 1980, Jerry Parr of Radian Corporation and Bill Warren and John Tarbell of E.C. Jordan Company initiated the second more intensive phase of the sampling effort. A total of 41 sample sets was collected during a two-week period beginning on 25 February. Samples for extractable organics were extracted and concentrated on-site.

2.1 Intensive Sampling Effort - Description of Samples

Samples were collected from two processes, the full-scale batch process and the pilot plant process, with emphasis on the pilot plant process. Each sample set consisted of the following sub-samples:

- 1 ℓ collected in glass for extractable organics;
- 1 ℓ collected in plastic for trace metals;
- 1 ℓ collected in plastic for color, COD and chloride; and
- 16 mℓ collected in a glass vial for volatile organics.

Composite grab samples were obtained by collecting grab samples at periodic intervals. Depending on the time of compositing, separate vials for volatile organics at different times were collected.

Six separate sampling efforts, designated as sampling episodes were conducted during the intensive sampling program. Each sampling episode was designed to evaluate one aspect of the treatment process as summarized in Table 2-1.

Sample points were designated by function rather than location. For the batch system there were three sample points:

- Influent (E-Stage effluent);
- Influent to Column 2 (Column 1 effluent); and
- Effluent (Effluent from Column 2).

The pilot system was complicated by the addition of the C-Stage treatment section. In addition to the three E-Stage sample points, the pilot plant process contained:

- C-Column influent (effluent from C-Stage);
- C-Column effluent; and
- Eluent.

These sample points are shown schematically in Figure 2-1.

2.2 Collection of Effluent Samples

Table 2-2 summarizes the samples collected in each episode. A unique field sample number was assigned to each subsample which consisted of the date the sample was collected, a letter code for the sample type and an assigned number for each

TABLE 2-1. SUMMARY OF SAMPLING EFFORTS

Sampling Episode	Date	System	Purpose	Number of Samples Collected
1	2/26/80	Batch	Composition at early, middle and late periods of cycle	7
2	3/04/80	Batch	Composition over complete cycle	3
3	3/04/80	Pilot	Composition over complete cycle	5
4	3/05/80	Pilot	Composition over complete cycle	5
5	3/05/80	Pilot	Composition at various times during cycle; follow resin bed	13
6	3/06/80	Pilot	Over extend life and performance of resin	8

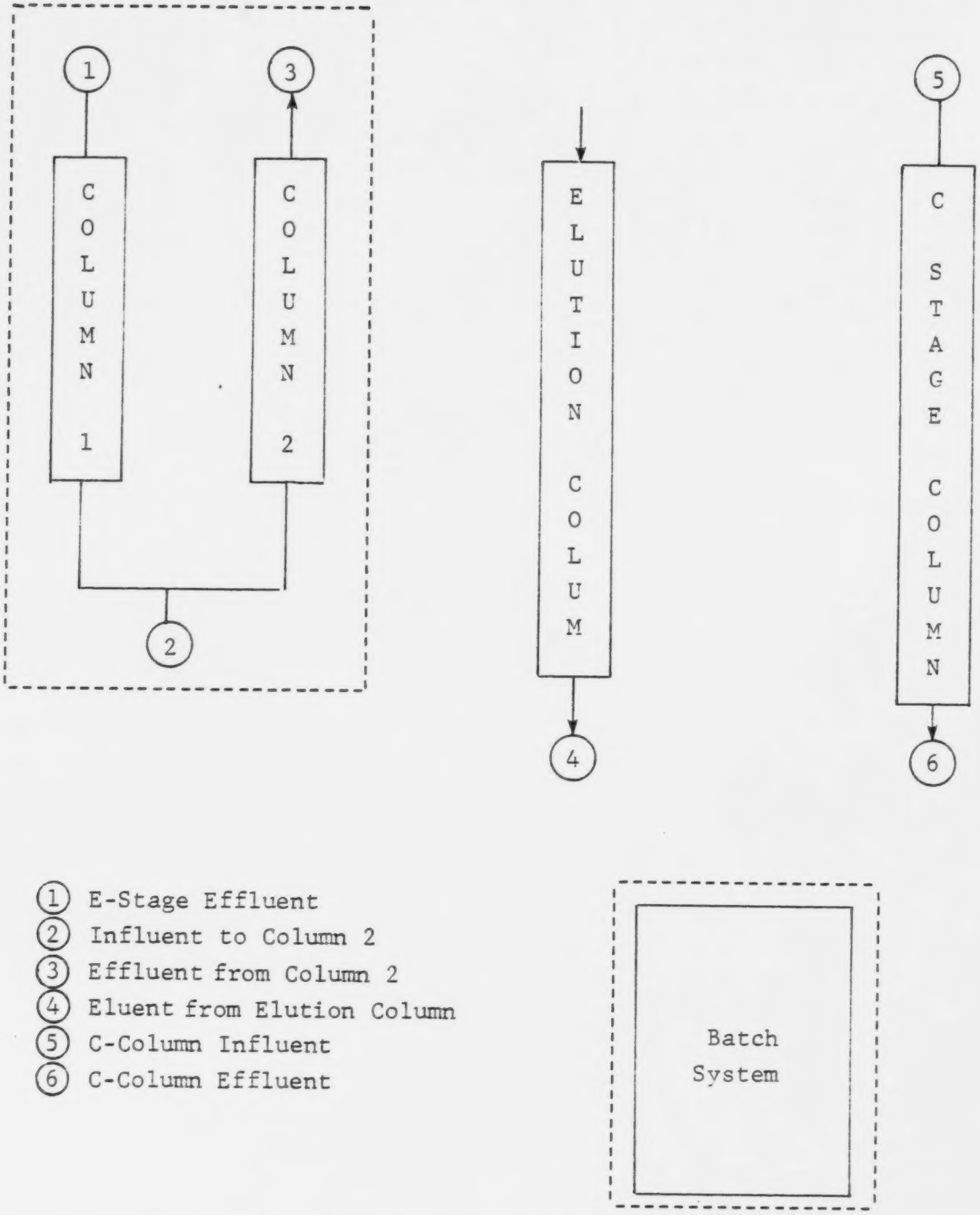
①
③
COLUMN 1
COLUMN 2
②
ELUTION COLUMN
④
⑤
C STAGE COLUMN
⑥
① E-Stage Effluent
② Influent to Column 2
③ Effluent from Column 2
④ Eluent from Elution Column
⑤ C-Column Influent
⑥ C-Column Effluent
Batch System

FIGURE 2-1. DESCRIPTION OF SAMPLE POINT LOCATIONS

TABLE 2-2.

SUMMARY OF SAMPLES COLLECTED: EVALUATION OF ION EXCHANGE TECHNOLOGY

	Sample Point	Description	Field Sample Number			Laboratory Sample Number		
			VOA	LLE	TM	VOA	LLE	TM
EPISODE 1	2	Column 2 Influent, 11:15	26V1	26E1	26M1	5081	5067	5194
2/26/80	3	Effluent, 10:15	26V2	26E2	26M2	5082	5068	5195
Batch	1	Influent, Composite	26V3(A,B,C)	26E3	26M3	5083	5069	5196
	3	Effluent, 11:15	26V4	26E4	26M4	5084	5070	5197
	3	Effluent, 12:15	26V5	26E5	26M5	5085	5071	5198
	2	Column 2 Influent, 10:15	26V6	26E6	26M6	5086	5072	5199
	2	Column 2 Influent, 12:15	26V7	26E7	26M7	5087	5073	5200
EPISODE 2	1	Influent	4V6(A,B)	4E6	4M6	5140	5125	5206
3/04/80	2	Column 2 Influent	4V7(A,B)	4E7	4M7	5141	5126	5207
Batch	3	Effluent	4V8(A,B,)	4E8	4M8	5142	5127	5208
EPISODE 3	1	Influent	4V1(A,B,C,D)	4E1	4M1	5134	5120	5201
3/04/80	2	Column 2 Influent	4V2(A,B,C,D)	4E2	4M2	5135	5121	5202
Pilot	3	Effluent	4V3(A,B,C,D)	4E3	4M3	5136	5122	5203
	4	C-Influent	4V4(A,B,C,D)	4E4	4M4	5137	5123	5204
	5	C-Effluent	4V5(A,B,C,D)	4E5	4M5	5138	5124	5205
EPISODE 4	1	Influent	5V14(A,B,C)	5E14	5M14	5156	5129	5222
3/05/80	2	Column 2 Influent	5V15(A,B,C)	5E15	5M15	5157	5130	5223
Pilot	3	Effluent	5V16(A,B,C)	5E16	5M16	5158	5131	5224
	4	C-Influent	5V17(A,B,C)	5E17	5M17	5159	5132	5225
	5	C-Effluent	5V18(A,B,C)	5E18	5M18	5160	5133	5226

Notes: VOA = Volatile Organics Analysis by the purge and trap technique.
LLE = Liquid Liquid Extraction for the acid/neutral fraction.
TM = Trace Metals samples.

TABLE 2-2.
SUMMARY OF SAMPLES COLLECTED: EVALUATION OF ION EXCHANGE TECHNOLOGY (Continued)

	Sample Point	Description	Field Sample Number			Laboratory Sample Number		
			VOA	LLE	TM	VOA	LLE	TM
EPISODE 5 3/05/80 Pilot Resin Study	0-70*	Bed 1 Influent	5V1	5E1	5M1	5143	5171	5209
	0-70*	Bed 1 Effluent	5V2	5E2	5M2	5144	5172	5210
	0-70*	Bed 2 Influent	5V3	5E3	5M3	5145	5173	5211
	80-150*	Bed 1 Influent	5V4	5E4	5M4	5146	5174	5212
	80-150*	Bed 1 Effluent	5V5	5E5	5M5	5147	5175	5213
	35-85*	C-Effluent	5V6	5E6	5M6	5148	5176	5214
	95-135*	C-Effluent	5V7	5E7	5M7	5149	5177	5215
		Strong Eluent	5V8	5E8	5M8	5150	5128	5216
	80-150*	Column 1 Influent	5V9	5E9	5M9	5151	5178	5217
	40-150*	C-Influent	5V10	5E10	5M10	5152	5179	5218
	160-230*	Bed 1 Influent	5V11	5E11	5M11	5153	5180	5219
	160-230*	Bed 1 Effluent	5V12	5E12	5M12	5154	5181	5220
	160-230*	Bed 4 Effluent	5V13	5E13	5M13	5155	5182	5221
EPISODE 6 3/06/80 Pilot Extended Resin Study	1	Column Influent, 6-hr Composite	6V1(A-F)	6E1	6M1	5161	5183	5227
	2	Column 2 Influent, 0-2 hours	6V2(A,B)	6E2	6M2	5162	5184	5228
	3	Column 2 Effluent 0-2 hours	6V3(A,B)	6E3	6M3	5163	5185	5229
	2	Column 2 Influent 2-4 hours	6V4(A,B)	6E4	6M4	5164	5186	5230
	3	Column 2 Effluent 2-4 hours	6V5(A,B)	6E5	6M5	5165	5187	5231
	2	Column 2 Influent 4-6 hours	6V6(A,B)	6E6	6M6	5166	5188	5232
	3	Column 2 Effluent 4-6 hours	6V7(A,B)	6E7	6M7	5167	5189	5233
	5	C-Column Effluent 2½-6 hours	6V8(A-D)	6E8	6M8	5168	5190	5234
SPECIAL SAMPLES		VOA Sample for Recovery	6V9	---	---	5169	---	---
		LAB Tap Water (Plant Influent)	---	9E1	---	---	5191	---
		20 μℓ Spike	---	9E2	---	---	5192	---
		300 mℓ Blank MeCl$_2$ from Screening	---	9E3	---	---	5193	---
Batch 2/15/80 Screening		Plant Effluent			---	4978	4974	---
	1	Influent			---	4979	4975	---
	3	Column 2 Effluent			---	4980	4976	---

*Minutes

sample. Additional letter codes (A,B,C,D,E) were assigned to grab volatiles collected at different times.

In addition to the 41 effluent samples collected in the intensive phase of the sampling, Table 2-2 lists the three samples collected during the initial phase and some special samples collected for specific purposes. A brief description of each sampling episode is enclosed below.

Episode 1

Samples were collected over a normal 3-hour cycle of the batch system. Three 1-hour composites were collected at the effluent and Column 2 influent sites. A single 3-hour composite was obtained of the influent.

Episode 2

A single 3-hour composite was collected at each sample point in the batch system.

Episode 3

Composite samples were collected over a complete 7-hour cycle of the pilot plant at each site designated in Table 2-2.

Episode 4

A repeat of the sampling conducted the previous day at the pilot system. This episode was to check the day-to-day variability and to serve as a control for Episode 5.

Episode 5

Collected the same day as Episode 4, these samples were collected at various stages in the cycle. At the start of the sampling period, the resin bed which had just been transferred from backwash to E-Stage final treatment was designated Bed 1. The other resin bed in the E-Stage was designated Bed 2 and the resin bed which was treating the C-Stage effluent was designated Bed 4. Samples were collected at different intervals of the influent or effluent to these resin beds independent of their location in the process at that particular time.

Figure 2-2 illustrates the positions of each bed during the sampling period.

Episode 6

During a normal resin cycle, a resin column treats E-Stage effluent for a total of 4 hours, 2 hours in initial treatment (Column 1) and 2 hours in final treatment (Column 2). In this episode the resin beds were not moved at 4 hours as usual. Thus, one resin bed was in the cycle for a total of 6 hours, 2 hours as final treatment and 4 hours as initial.

2.3 Special Samples

One volatile and three extractable samples were collected for special purposes. Sample 5169 was a sample of Column 2 effluent which was spiked in the field with deuterated benzene to a concentration level of 31 ppb. Sample 5191 was a sample of laboratory tap water (plant intake water) which was collected to investigate the presence of some atypical compounds (e.g., hexachlorobutadiene) which were detected in the initial screening samples. A sample of

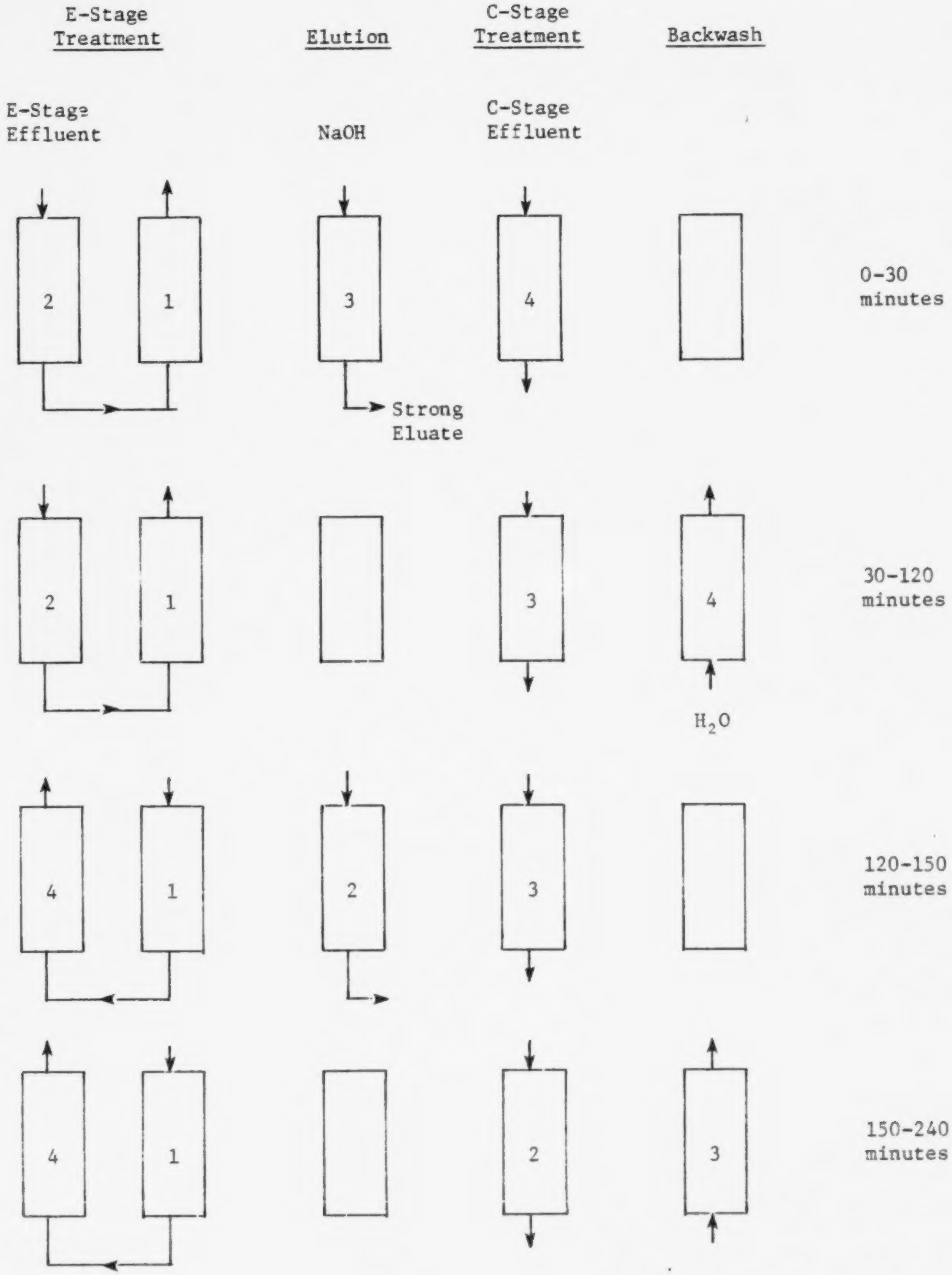
E-Stage Treatment
Elution
C-Stage Treatment
Backwash
E-Stage Effluent
NaOH
C-Stage Effluent
2
1
3
4
0-30 minutes
Strong Eluate
2
1
3
4
30-120 minutes
H_2O
4
1
2
3
120-150 minutes
4
1
2
3
150-240 minutes

FIGURE 2-2. ILLUSTRATION OF BED POSITIONS

143

the methylene chloride employed to extract the screening samples (Sample 5193) was also obtained to investigate this unusual occurrence. Finally, a sample of the spiking solution used for the extractable organics (Sample 5192) was prepared to serve as a control for the extractable spikes. This solution was prepared at the 20 μg/mℓ concentration level.

2.4 Disposition of Samples and Sample Control

The samples for volatile organics, extractable organics and metals were shipped to Radian's Austin laboratory by air freight. Analyses for color and COD were performed on-site by Billerud/Uddeholm personnel. Aliquots of the metals samples were also analyzed by Billerud/Uddeholm personnel for mercury.

Upon receipt at Radian, the samples were logged in and distributed to the appropriate laboratories for analyses. The volatile organics and metals samples were distributed directly to the GC-MS and trace metals laboratories for analysis while the extractable organics samples were first routed to Radian's sample preparation laboratory for additional treatment before analysis by GC-MS.

3.0 SAMPLE PREPARATION

Preparation of the organic and the trace element samples is described in the following subsections.

3.1 On-Site Extractions

Each aqueous sample was spiked with a solution containing three surrogate compounds: d_8-naphthalene, pentafluorophenol and d_{35}-stearic acid. The spiking levels ranged from 10 to 200 ppb depending on the sample. These internal standards served to provide quality control data on recovery efficiencies of every sample.

The samples for extractable organics were extracted on-site with methylene chloride at acidic pH. Each sample was serially extracted with three 100-mℓ portions of E. Merck Pesticide Quality methylene chloride. A centrifuge was employed between each extraction to break emulsions. The combined extracts were concentrated by Kuderna-Danish evaporation on a steam bath to a volume of 10 mℓ or less. Each concentrated extract was transferred to a 10-mℓ crimp-seal vial with a Teflon liner and sealed.

Table 3-1 summarizes the extraction of the various samples.

3.2 Methylation of Acid Neutral Extracts

After sample log-in at Radian, the methylene chloride extracts were concentrated and derivatized before GC-MS analysis. The extracts were concentrated to 1.0 mℓ on a micro Kuderna-Danish concentrator. Half of the extract (0.5 mℓ) was then removed for derivatization and the remaining half stored.

TABLE 3-1. SUMMARY OF ON-SITE EXTRACTIONS

Field Sample Number	Date Extracted	Volume of Sample Extracted (mℓ)	Amount of Spike (μg)
26E1	2/26/80	925	20
26E2	2/26/80	930	10
26E3	2/27/80	940	50
26E4	2/27/80	980	10
26E5	2/27/80	960	10
26E6	2/28/80	950	20
26E7	2/28/80	970	20
4E1	3/05/80	650	50
4E2	3/05/80	640	20
4E3	3/05/80	640	10
4E4	3/05/80	600	20
4E5	3/05/80	600	10
4E6	3/06/80	920	50
4E7	3/06/80	880	20
4E8	3/06/80	920	10
5E1	3/07/80	920	20
5E2	3/07/80	960	10
5E3	3/07/80	920	50
5E4	3/07/80	950	50
5E5	3/07/80	950	20
5E6	3/07/80	930	20
5E7	3/08/80	800	10
5E8	3/06/80	1000	200
5E9	3/08/80	950	50
5E10	3/08/80	630	20
5E11	3/08/80	1000	50
5E12	3/08/80	980	20
5E13	3/08/80	900	10
5E14	3/06/80	920	50
5E15	3/06/80	900	20
5E16	3/06/80	900	10
5E17	3/06/80	930	20
5E18	3/06/80	900	10
6E1	3/08/80	1000	50
6E2	3/08/80	940	20
6E3	3/08/80	940	10
6E4	3/08/80	740	20
6E5	3/09/80	780	10
6E6	3/09/80	950	20
6E7	3/09/80	960	10
6E8	3/09/80	890	10

Derivatization of the extract was accomplished by adding 0.5 mℓ of a 9:1 mixture of a diazomethane solution and methanol. The diazomethane solution was prepared from Diazald according to the directions supplied by Aldrich Chemical and contains approximately 3 percent diazomethane in diethyl ether.

After 30 minutes, the derivatized extract was reconcentrated to 0.5 mℓ and transferred to a crimp-top vial. The derivatized extract was then analyzed by GC-MS.

3.3 Trace Elements

Water samples were digested before analysis using digestions as prescribed in "Sampling and Analysis Procedure for Screening of Industrial Effluents for Priority Pollutants" US EPA, Cincinnati, Ohio, March, 1977. The sample preparation calls for two digestions to be performed on each sample:

a) those metals which are first to be analyzed by flame atomic absorption (AA) techniques, and, if not detected, then analyzed by flameless AA -- Be, Cd, Cr, Cu, Ni, Pb, and Zn.

b) those metals to be analyzed by flameless techniques only.

A flow diagram for digestion and analysis of the samples is shown in Figure 3-1.

The HNO_3/H_2O_2 digestion is carried out by the addition of 3 mℓ (concentrated) HNO_3 and 3 mℓ (30%) H_2O_2 to 50 mℓ of sample. The sample is heated for 1 hour and diluted to 100 mℓ.

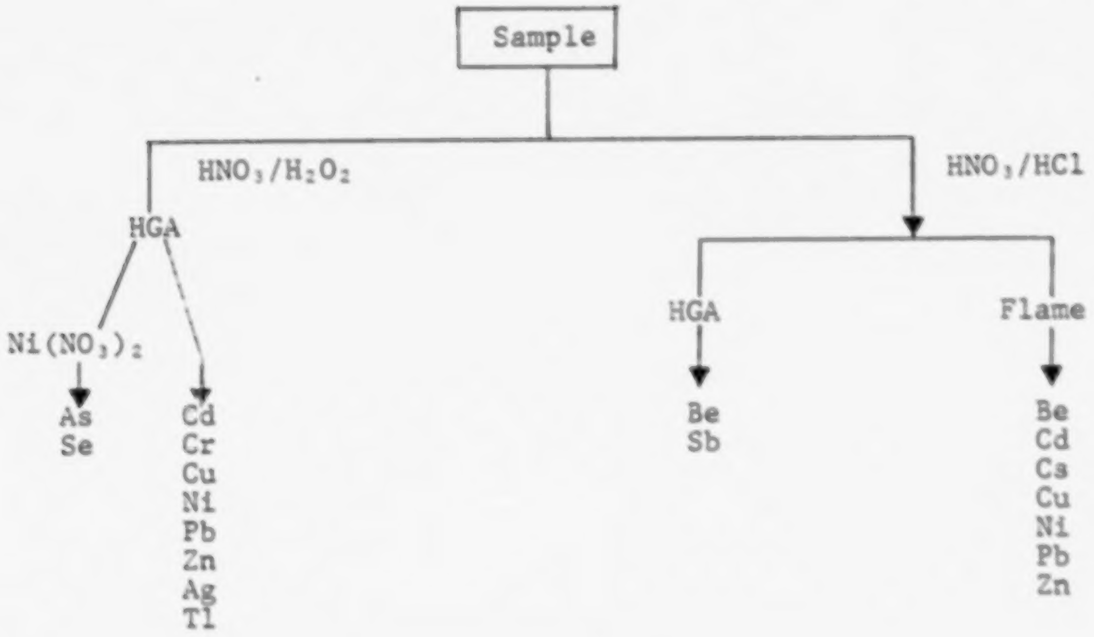
Sample
HNO_3/H_2O_2
HNO_3/HCl
HGA
$Ni(NO_3)_2$
As
Se
Cd
Cr
Cu
Ni
Pb
Zn
Ag
Tl
HGA
Flame
Be
Sb
Be
Cd
Cs
Cu
Ni
Pb
Zn

FIGURE 3-1. FLOW DIAGRAM FOR DIGESTION AND ANALYSIS

The digestion using HNO_3/HCl is performed by adding 3 mℓ HNO_3 and 3 mℓ HCl to 50 mℓ of sample. The sample is heated for 1 hour and diluted to volume.

4.0 GC-MS ANALYSES

Analyses in this study were performed according to established procedures developed by Gulf South Research Institute (GSRI) for the analysis of aqueous paper mill effluents. Minor modifications to the GSRI procedures were implemented to accommodate changes in the sample work-up procedure and differences in analytical columns. The following subsections describe in detail the procedures used in these studies.

4.1 GC-MS Analysis for Purgeable Organic Pollutants in Paper Mill Water Samples

The purgeable organic pollutants studied in this program were determined by gas chromatography-mass spectrometry (GC-MS). The method employed for these analyses is part of the EPA Protocol, "Sampling and Analysis Procedures," dated March, 1977, amended April, 1977. Purgeable pollutants analyzed in this study are summarized in Table 4-1.

Upon receiving samples from the Uddholm Mill at Radian, they were unpacked and logged in to a permanently bound notebook. The samples were stored in an organic-free refrigerator at 4°C until analyzed. A Tekmar LSC-1 sample concentrator was used for the purging/trapping/desorption procedures. Instead of the conventional stainless steel trap, glass-lined stainless steel tubing was used for the construction of the Tekmar trap. These glass-lined stainless steel traps provide an extra measure of inertness for compounds that could be sensitive to metal during the thermal desorption process.

Prior to the analysis of the purgeable samples each sample was spiked with 50 ppb each of three deuterated standards:

TABLE 4-1. COMPOUNDS STUDIED AT UDDEHOLM MILL

PURGEABLES

- Methylene chloride
- Trichlorofluoromethane
- 1,1-Dichloroethane
- Chloroform
- 1,2-Dichloroethane
- 1,1,1-Trichloroethane
- Bromodichloromethane
- Trichloroethylene
- Dibromochloromethane
- Benzene
- 1,1,2,2-Tetrachloroethane
- Tetrachloroethylene
- Toluene
- Chlorobenzene
- Ethylbenzene
- d_4-1,4-Dichloroethane*
- d_6-Benzene*
- d_8-Toluene*

EXTRACTABLES

- Phenol
- Isophorone
- Naphthalene
- Hexachlorobutadiene
- 2,4-Dichlorophenol
- 2,4,6-Trichlorophenol
- 2,3,5-Trichlorophenol
- Diethyl phthalate
- Trichloroguaiacol
- 4-Bromophenyl phenyl ether
- Tetrachloroguaiacol
- Pentachlorophenol
- Phenanthrene/Anthracene
- Dibutyl phthalate
- Heptadecanoic acid
- Fluoranthene
- Linoleic acid (C18:2)
- Linolenic acid (C18:3)
- Oleic acid (C18:1)
- Pyrene
- Pimaric acid
- Sandracopimaric acid
- Isopimaric acid
- Dehydroabietic acid
- Abietic acid
- Heneicosanoic acid (C21:0)
- Chrysene
- Chlorodehydroabietic acid (Isomer A)
- bis(2-Ethylhexyl) phthalate
- Chlorodehydroabietic acid (Isomer B)
- Dichlorodehydroabietic acid (Unknown isomer)
- Dioctyl phthalate
- Neoabietic acid
- 9,10-Dichlorostearic acid
- Pentafluorophenol*
- d_8-Naphthalene*
- d_{35}-Stearic acid)

---

*Internal standard spikes.

d_4-1,4-dichloroethane, d_6-benzene, and d_8-toluene. The subsequent quantiative analysis of these standards in each sample was used to demonstrate good recoveries of compounds from the purge and trap procedure.

In the purge and trap procedures, a 5-mℓ sample was placed in a special glass purging chamber along with two internal standards (bromochloromethane and 1,4-dichlorobutane) and helium gas was bubbled through the sample. As the volatile organics were stripped out of the water, they were trapped in the Tenax-silica gel glass-lined stainless steel trap. After the purging was completed, the trap was rapidly heated to 180°C and the absorbed organics were thermally desorbed onto the head of a cold gas chroamtographic column (-20°C). The 9-foot glass gas chromatographic column was packed with the EPA recommended 0.2% Carbowax 1500 coated on Carbopack C. When the thermal desorption was complete (8 minutes), the gas chromatograph oven was rapidly raised to 60°C. The temperature was held at 60°C for 4 minutes and then programmed at 170°C at 8°C per minute. The temperature was held at 170°C until all the pollutants were eluted.

Certain of the samples from the Uddeholm mill contained sufficient contamination to require a 1-mℓ sample size which was diluted with 4 mℓ of organic-free water and analyzed as stated above. Essentially all samples for volatile organic analysis were found to have extremely high levels of chloroform. These samples had to be re-analyzed by direct aqueous injection for their chloroform content using 2-$\mu\ell$ samples injected onto a 4'x2mm I.D. glass column packed with Chromosorb 101. The analysis temperature was 150°C and the chloroform was detected by selected ion monitoring techniques using masses m/e 83, 85, and 87. Quantitation was accomplished by the external standard method. These re-analyses were not in the original plans nor costs but without them the data would have been extremely limited since chloroform was the only compound in significant concentrations.

The GC detector in all cases was a repetitively scanned Hewlett-Packard 5982 mass spectrometer operated in the electron impact mode at 70 eV. All mass spectral data obtained from these analyses were stored on magnetic disc for later evaluation.

4.2 GC-MS Analysis of the Paper Mill Extractable Fractions

The acid/neutral extractable fractions obtained from the Uddeholm mill were previously discussed in Section 3.1. Water samples from the mill were spiked before extraction with three standards: pentafluorophenol, d_8-naphthalene, and d_{35}-stearic acid.

An internal standard (d_{10}-anthracene) was added to each concentrated sample extract for the quantification of nonpurgeable pollutants. Details of the quantification procedure are discussed in Section 4.3 of this document.

All extractable samples were analyzed by capillary GC-MS using a computerized Hewlett-Packard 5985 GC-MS system. The mass spectrometer was operated in the repetitive scanning and electron impact modes at 70 eV. The mass spectrometer was scanned from m/e 50 to m/e 400. All mass spectral data were stored on magnetic disc for later interpretation and quantification. The capillary analytical column used for this study was a 0.5 mm I.D. x 60 m long glass wall coated SE-30 column.

Samples were injected into the GC-MS in the splitless mode of operation. Typically a 1-μℓ injection was employed. The GC column was programmed from 100°C to 250°C at 8°C per minute after an initial 4-minute hold at 100°C. A helium carrier gas flow rate of 3.5 mℓ/minute and an injection port temperature of 290°C were employed.

The extractable analytes studied in this program are listed in Table 4-1. Neoabietic acid and sandaracopimaric acids were not required analyses in this contract but they are commonly present in the wastewaters of U.S. pulp mills. In addition, neoabietic acid has recently been found to give positive mutagenicity tests.* Therefore, Radian analyzed for these two potentially important pollutants at no extra cost.

4.3 GC-MS Identification and Quantification Techniques

The following subsections describe the analytical techniques used in this program to generate reliable qualitative and quantitative GC-MS data.

4.3.1 Identification of Organic Paper Mill Pollutants

The EPA Priority Pollutant Protocol used in this program specifies three conditions that must be met for the qualitative identification of a compound. First, certain characteristic ions of the compound must be found to maximize in the same spectrum. Second, the time at which the chromatographic peak occurs must be within a retention time window of ±1 minute of the expected retention time. Finally, the ratios of the intensities of the characteristic ions must be within ±20 percent of the measured ion intensities found from the analysis of a standard.

Radian utilized standard GC-MS data system software to display mass chromatograms of the characteristic ions for each compound. For example, Figure 4-1 presents a selected ion search for the compound, naphthalene, in a base/neutral extract. This analysis was run on a packed analytical column according to the EPA Priority Pollutant Protocol.

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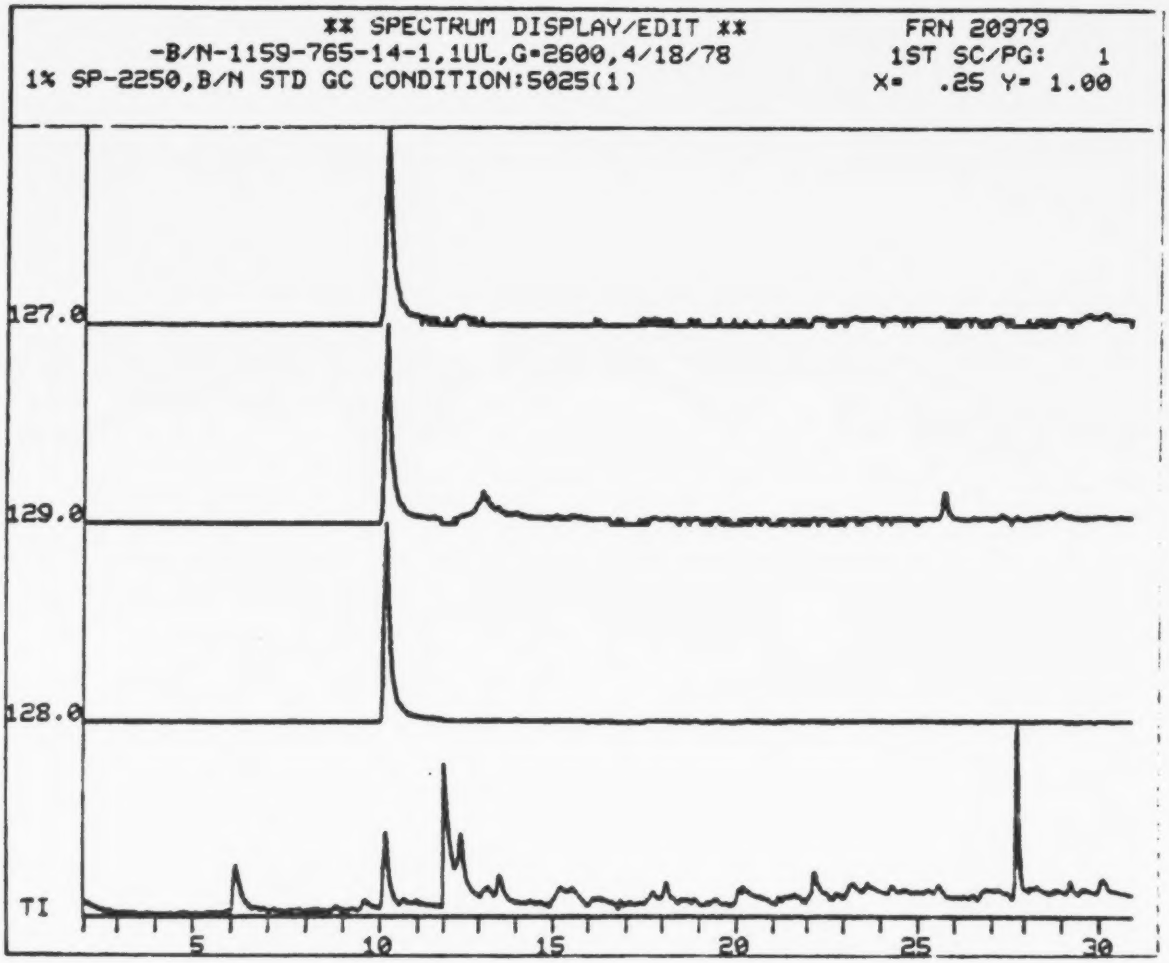
*Private Communication: Bob Claeys, NCASI, Corvallis, Oregon.



```
                    ** SPECTRUM DISPLAY/EDIT **            FRN 20979
            -B/N-1159-765-14-1,1UL,G=2600,4/18/78          1ST SC/PG:    1
 1% SP-2250,B/N STD GC CONDITION:5025(1)                  X=   .25 Y= 1.00
```

FIGURE 4-1. SELECTED ION SEARCH FOR NAPHTHALENE

It was known from standard analyses that naphthalene eluted at 10.1 minutes and contains the characteristic ions and intensities, m/e 123 (100%), m/e 129 (11%) and m/e 127 (10%). The selected ion searches for these ions indicate a maxima at 10.4 minutes. Examination of the mass spectrum of this peak indicates that the ions are in the proper ratio as indicated in Figure 4-2. Thus, naphthalene was identified in this example.

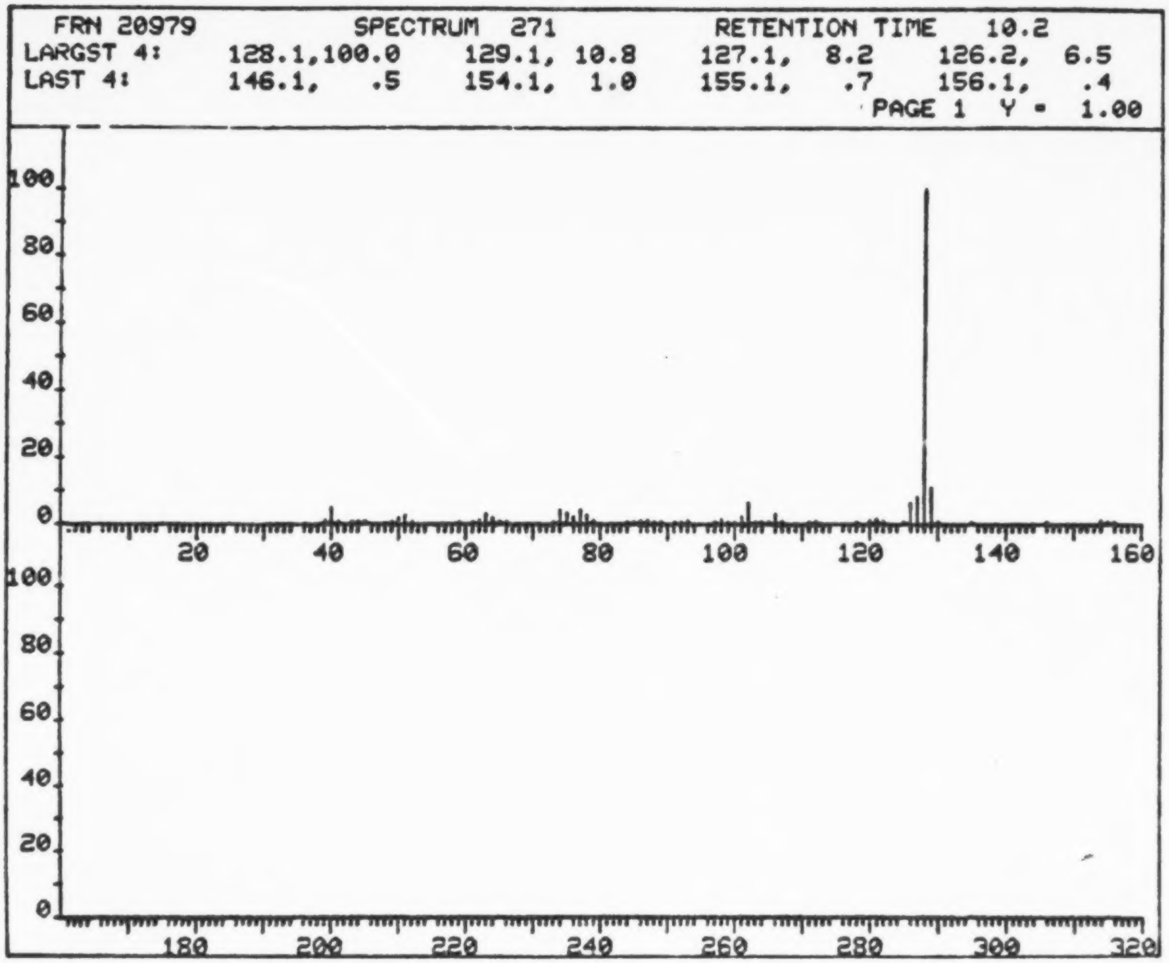
The EPA has specified two to four ions and their relative intensities for identification of each organic Priority Pollutant. Radian has verified these parameters for the paper mill pollutant studied in this program by analysis of standards. The ion intensity ratios used reflect the values obtained from the analysis of standards on Radian's instruments.

4.3.2 Quantification of Priority Pollutants by GC-MS

After a compound has been identified, the quantification of that compound must be performed. The software program utilized for identification was also employed for quantitation. The area under selected ion plots for each identified pollutant was measured. These areas were then compared to the area obtained from the corresponding selected ion plot for the internal standard. Response factors were determined for all of the compounds in this study relative to the appropriate internal standards (bromochloromethane, dichlorobutane, d_{10}-anthracene) by analysis of standards. The response factors were calculated as follows:

$$RF_c = \frac{A_c \times C_a}{A_a \times C_c},$$

where A_c is the integrated area of the characteristic ion of the compound at a known concentration (C_c) and A_a is the integrated area of the characteristic ion of the internal standard at concentraction, C_a.



```
 FRN 20979            SPECTRUM  271            RETENTION TIME   10.2
LARGST 4:      128.1,100.0      129.1, 10.8     127.1,  8.2      126.2,  6.5
LAST 4:        146.1,    .5     154.1,  1.0     155.1,   .7      156.1,   .4
                                                          PAGE 1  Y =  1.00
```

FIGURE 4-2. MASS SPECTRUM OF NAPHTHALENE
IN A BASE/NEUTRAL SAMPLE EXTRACT

The concentration of a compound is then calculated according to the following equation:

$$C_c = \frac{A_c \times C_a}{A_a \times RF_c} \quad ,$$

where A_c, A_a and C_a are the integrated areas and internal standard concentration in the sample and RF is the previously determined response factor. In the previous example for naphthalene, the calculated area under the 128 ion at 10.4 minutes was 55187. The area of the 188 ion of the internal standard, d_{10}-anthracene, gave an area of 19873. The response factor for naphthalene (m/e 128) to d_{10}-anthracene (m/e 188) was determined to be 1.2 The internal standard was added to the sample extracts at a level of 200 ppm; therefore, the concentration of naphthalene (C_c) in the extract can be calculated as follows:

$$C_c = \frac{55187}{19873} \times \frac{20}{1.2} = 46 \text{ ppm.}$$

The concentration of naphthalene in the original water sample is determined by multiplying the concentration found in the extract by the ratio of the extract volume divided by the volume of the original water sample. Attention must be given to expressing the concentrations and volumes in the same units.

4.4 Analytical Data

The analyses for each sample are presented in the following pages. Forms were prepared for both the purgeable samples and the extractable samples. Tables 4-2 and 4-3 contain the results from the preliminary Screening Analyses.

TABLE 4-2. SCREENING SAMPLES FOR PURGEABLE PRIORITY POLLUTANTS

	Sample Concentrations (ppb)		
Compounds Found	Mill Influent	Kraft Effluent	After Ion Exchange
Chloroform	39	9200	4600
1,2-Dichloroethane	--	--	1.4
Bromodichloromethane	2.5	5.5	3.2
Trichloroethylene	4.9	4.9	5.0
Benzene	--	1.1	--
Tetrachloroethylene	1.6	1.8	2.6
Toluene	--	1.3	1.9

TABLE 4-3. SCREENING SAMPLES FOR EXTRACTABLE PRIORITY POLLUTANTS

	Sample Concentrations (ppb)		
Compounds Found	Mill Influent	Kraft Effluent	After Ion Exchange
Hexachlorobutadiene	6.2	7.2	5.5
Diethyl phthalate	--	1.5	--
4-Bromophenyl phenyl ether	--	8.8	--
Di-n-butyl phthalate	1.7	1.3	1.2
bis(2-Ethylhexyl) phthalate	11	1.8	2.8
Phenol	--	6.1	--
2,4-Dichlorophenol	--	59	1.4
2,4,6-Trichlorophenol	--	160	2.7
Pentachlorophenol	--	10	8.6

4.4.1 Results of the Purgeable Analyses

The following pages are copies of the purgeable analytical results. Each form contains data on the identity of each sample analyzed, the date it was analyzed, the initials of the analyst, each compound analyzed, its expected retention time (in minutes), the ion selected for quantification, other characteristic ions and their percent abundance and the concentrations expressed in µg/ℓ.

4.4.2 Results of the Extractable Analyses

The following pages are copies of the extractable analytical results. Each form contains data on the identity of each sample analyzed, the data it was analyzed, the initials of the analyst, the amount of the deuterated internal standard spikes, the actual amount of the sample extracted (in liters), the identity of each compound analyzed, its expected retention time (in minutes), the ion selected for quantification, other characteristic ions and their percent abundance, the concentration factor (based on the fraction of 1.0 ℓ extracted) and the concentrations expressed in µg/ℓ.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5081
FRN: 14840 CRN: 20

(1) Date Analyzed: 3/25/80 Analyst: LDG
(2) Date Analyzed: 3/30/80 Analyst: CFM

I.S. Ratio: 2.6
Sample Size: 1 mℓ

	Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	CIS/RF	Ax/An	Conc. Factor	Conc. (μg/ℓ)
1.	Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	0.052	X5	<1
2.	Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3.	1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4.	Chloroform	5.0	83 (100)	85 (66)	5.5			4500*
5.	1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6.	1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7.	Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.017	X5	6.5
8.	Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.14	X5	4.3
9.	Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10.	Benzene	11.3	78 (100)		2.6	0.22	X5	2.9
11.	1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12.	Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.072	X5	2.7
13.	Toluene	18.0	92 (78)	91 (100)	3.6	0.30	X5	5.4
14.	Chlorobenzene	19.0	112 (100)	114 (33)	2.6	0.14	X5	1.8
15.	Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16.	d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	0.65	X5	55
17.	d_6-Benzene	11.3	84 (100)		1.6	7.4	X5	59
18.	d_8-Toluene	18.0	100 (78)	98 (100)	2.7	4.2	X5	57

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5082	(1) Date Analyzed: 3/25/80	Analyst: PHL	I.S. Ratio: 2.3
FRN: 14836 CRN: 20	(2) Date Analyzed: 3/30/80	Analyst: CFM	Sample Size: 1 mℓ

	Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	$\frac{\text{CIS}}{\text{RF}}$	$\frac{\text{Ax}}{\text{An}}$	Conc. Factor	Conc. ($\mu g/\ell$)
1.	Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	0.046	X5	<1
2.	Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3.	1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4.	Chloroform	5.0	83 (100)	85 (66)	5.5			1700*
5.	1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6.	1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7.	Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.0065	X5	2.5
8.	Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.15	X5	4.6
9.	Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10.	Benzene	11.3	78 (100)		2.6	0.24	X5	3.1
11.	1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12.	Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.047	X5	1.7
13.	Toluene	18.0	92 (78)	91 (100)	3.6	0.25	X5	4.5
14.	Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15.	Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16.	d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	0.67	X5	57
17.	d_6-Benzene	11.3	84 (100)		1.6	8.1	X5	57
18.	d_8-Toluene	18.0	100 (78)	98 (100)	2.7	4.1	X5	55

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5083
FRN: 14849 CRN: 16

(1) Date Analyzed: 3/27/80 Analyst: LDG
(2) Date Analyzed: 3/30/80 Analyst: CFM

I.S. Ratio: 2.4
Sample Size: 1 mℓ

	Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	CIS/RF	Ax/An	Conc. Factor	Conc. (μg/ℓ)
1.	Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	0.34	X5	<1
2.	Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3.	1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4.	Chloroform	5.0	83 (100)	85 (66)	5.5			5500*
5.	1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6.	1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7.	Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.033	X5	13
8.	Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.093	X5	2.8
9.	Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10.	Benzene	11.3	78 (100)		2.6	0.20	X5	2.6
11.	1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12.	Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.075	X5	2.8
13.	Toluene	18.0	92 (78)	91 (100)	3.6	0.19	X5	3.4
14.	Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15.	Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16.	d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	0.60	X5	51
17.	d_6-Benzene	11.3	84 (100)		1.6	7.3	X5	58
18.	d_8-Toluene	18.0	100 (78)	98 (100)	2.7	4.0	X5	54

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5084
FRN: 14842 CRN: 20

(1) Date Analyzed: 3/25/80 Analyst: LDG
(2) Date Analyzed: 3/30/80 Analyst: CFM

I.S. Ratio: 2.7
Sample Size: 1 mℓ

Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	CIS/RF	Ax/An	Conc. Factor	Conc. (μg/ℓ)
1. Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	0.135	X5	1.8
2. Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3. 1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4. Chloroform	5.0	83 (100)	85 (66)	5.5			3800*
5. 1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6. 1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7. Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.01	X5	3.8
8. Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.291	X5	8.9
9. Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10. Benzene	11.3	78 (100)		2.6	0.296	X5	3.8
11. 1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12. Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.088	X5	3.3
13. Toluene	18.0	92 (78)	91 (100)	3.6	0.1	X5	1.8
14. Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15. Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16. d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	0.569	X5	48
17. d_6-Benzene	11.3	84 (100)		1.6	8.45	X5	68
18. d_8-Toluene	18.0	100 (78)	98 (100)	2.7	4.06	X5	55

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5085
FRN: 14845 CRN: 16

(1) Date Analyzed: 3/27/80 Analyst: LDG
(2) Date Analyzed: 3/30/80 Analyst: CFM

I.S. Ratio: 2.8
Sample Size: 1 mℓ

	Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	CIS/RF	Ax/An	Conc. Factor	Conc. (µg/ℓ)
1.	Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	0.19	X5	2.5
2.	Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3.	1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4.	Chloroform	5.0	83 (100)	85 (66)	5.5			5300*
5.	1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6.	1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7.	Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.019	X5	7.2
8.	Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.18	X5	5.5
9.	Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10.	Benzene	11.3	78 (100)		2.6	0.23	X5	3.0
11.	1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12.	Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.063	X5	2.3
13.	Toluene	18.0	92 (78)	91 (100)	3.6	0.32	X5	5.8
14.	Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15.	Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16.	d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	0.71	X5	60
17.	d_6-Benzene	11.3	84 (100)		1.6	8.4	X5	67
18.	d_8-Toluene	18.0	100 (78)	98 (100)	2.7	5.0	X5	68

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5086
FRN: 14847 CRN: 16

(1) Date Analyzed: 3/27/80 Analyst: LDG
(2) Date Analyzed: 3/30/80 Analyst: CFM

I.S. Ratio: 2.3
Sample Size: 1 mℓ

	Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	$\frac{\text{CIS}}{\text{RF}}$	$\frac{\text{Ax}}{\text{An}}$	Conc. Factor	Conc. (µg/ℓ)
1.	Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	0.058	X5	<1
2.	Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3.	1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4.	Chloroform	5.0	83 (100)	85 (66)	5.5			3400*
5.	1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6.	1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7.	Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.015	X5	5.7
8.	Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.15	X5	4.6
9.	Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10.	Benzene	11.3	78 (100)		2.6	0.27	X5	3.5
11.	1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12.	Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.071	X5	2.6
13.	Toluene	18.0	92 (78)	91 (100)	3.6	0.18	X5	3.2
14.	Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15.	Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16.	d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	0.66	X5	56
17.	d_6-Benzene	11.3	84 (100)		1.6	7.0	X5	56
18.	d_8-Toluene	18.0	100 (78)	98 (100)	2.7	3.9	X5	53

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5087
FRN: 14838 CRN: 20

(1) Date Analyzed: 3/25/80 Analyst: PHL
(2) Date Analyzed: 3/30/80 Analyst: CFM

I.S. Ratio: 2.5
Sample Size: 1 mℓ

	Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	CIS / RF	Ax / An	Conc. Factor	Conc. (μg/ℓ)
1.	Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	0.091	X5	1.2
2.	Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3.	1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4.	Chloroform	5.0	83 (100)	85 (66)	5.5			8900*
5.	1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6.	1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7.	Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.038	X5	14
8.	Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.14	X5	4.3
9.	Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10.	Benzene	11.3	78 (100)		2.6	0.18	X5	2.3
11.	1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12.	Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.10	X5	3.7
13.	Toluene	18.0	92 (78)	91 (100)	3.6	0.32	X5	5.8
14.	Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15.	Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16.	d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	0.63	X5	53
17.	d_6-Benzene	11.3	84 (100)		1.6	7.2	X5	58
18.	d_8-Toluene	18.0	100 (78)	98 (100)	2.7	4.3	X5	58

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5140
FRN: 14831 CRN: 195

(1) Date Analyzed: 3/24/80 Analyst: LDG
(2) Date Analyzed: 3/27/80 Analyst: JEH

I.S. Ratio: 2.6
Sample Size: 1 mℓ

Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	CIS/RF	Ax/An	Conc. Factor	Conc. (μg/ℓ)
1. Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	0.05	X5	ND
2. Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3. 1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4. Chloroform	5.0	83 (100)	85 (66)	5.5			7700*
5. 1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6. 1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7. Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.026	X5	9.9
8. Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.094	X5	2.9
9. Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10. Benzene	11.3	78 (100)		2.6	0.30	X5	3.8
11. 1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12. Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.064	X5	2.4
13. Toluene	18.0	92 (78)	91 (100)	3.6	0.22	X5	4.0
14. Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15. Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16. d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	0.61	X5	52
17. d_6-Benzene	11.3	84 (100)		1.6	7.1	X5	57
18. d_8-Toluene	18.0	100 (78)	98 (100)	2.7	4.4	X5	60

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5141	(1) Date Analyzed: 3/23/80	Analyst: PHL	I.S. Ratio: 2.7
FRN: 14820 CRN: 180	(2) Date Analyzed: 3/30/80	Analyst: JEM	Sample Size: 1 mℓ

	Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	CIS/RF	Ax/An	Conc. Factor	Conc. (μg/ℓ)
1.	Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	0.66	X5	<1
2.	Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3.	1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4.	Chloroform	5.0	83 (100)	85 (66)	5.5			8400*
5.	1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6.	1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7.	Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.02	X5	7.6
8.	Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.147	X5	4.5
9.	Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10.	Benzene	11.3	78 (100)		2.6	0.23	X5	3.0
11.	1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12.	Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.07	X5	2.6
13.	Toluene	18.0	92 (78)	91 (100)	3.6	0.193	X5	3.5
14.	Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15.	Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16.	d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	0.55	X5	47
17.	d_6-Benzene	11.3	84 (100)		1.6	8.32	X5	67
18.	d_8-Toluene	18.0	100 (78)	98 (100)	2.7	4.7	X5	63

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5142
FRN: 14818 CRN: 171

(1) Date Analyzed: 3/23/80 Analyst: PHL
(2) Date Analyzed: 3/30/80 Analyst: CFM

I.S. Ratio: 2.3
Sample Size: 1 mℓ

	Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	$\frac{\text{CIS}}{\text{RF}}$	$\frac{\text{Ax}}{\text{An}}$	Conc. Factor	Conc. (μg/ℓ)
1.	Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	0.042	X5	<1
2.	Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3.	1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4.	Chloroform	5.0	83 (100)	85 (66)	5.5			7000*
5.	1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6.	1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7.	Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.013	X5	4.9
8.	Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.19	X5	5.8
9.	Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10.	Benzene	11.3	78 (100)		2.6	0.25	X5	3.3
11.	1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12.	Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.086	X5	3.2
13.	Toluene	18.0	92 (78)	91 (100)	3.6	0.12	X5	2.2
14.	Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15.	Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16.	d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	0.54	X5	46
17.	d_6-Benzene	11.3	84 (100)		1.6	6.9	X5	55
18.	d_8-Toluene	18.0	100 (78)	98 (100)	2.7	4.3	X5	58

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5134	(1) Date Analyzed: 3/24/80 Analyst: LDG	I.S. Ratio: 2.3
FRN: 14829 CRN: 195	(2) Date Analyzed: 3/30/80 Analyst: CFM	Sample Size: 1 mℓ

	Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	$\frac{\text{CIS}}{\text{RF}}$	$\frac{\text{Ax}}{\text{An}}$	Conc. Factor	Conc. (μg/ℓ)
1.	Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	0.072	X5	<1
2.	Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3.	1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4.	Chloroform	5.0	83 (100)	85 (66)	5.5			7400*
5.	1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6.	1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7.	Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.031	X5	12
8.	Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.093	X5	2.8
9.	Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10.	Benzene	11.3	78 (100)		2.6	0.31	X5	4.0
11.	1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12.	Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.074	X5	2.7
13.	Toluene	18.0	92 (78)	91 (100)	3.6	0.18	X5	3.2
14.	Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15.	Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16.	d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	0.73	X5	62
17.	d_6-Benzene	11.3	84 (100)		1.6	7.2	X5	58
18.	d_8-Toluene	18.0	100 (78)	98 (100)	2.7	4.2	X5	57

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5135
FRN: 14825 CRN: 180

(1) Date Analyzed: 3/24/80 Analyst: PHL
(2) Date Analyzed: 3/30/80 Analyst: JEM

I.S. Ratio: 2.6
Sample Size: 1 mℓ

	Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	CIS/RF	Ax/An	Conc. Factor	Conc. (μg/ℓ)
1.	Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	0.05	X5	<1
2.	Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3.	1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4.	Chloroform	5.0	83 (100)	85 (66)	5.5			7300*
5.	1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6.	1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7.	Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.02	X5	7.6
8.	Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.18	X5	5.5
9.	Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10.	Benzene	11.3	78 (100)		2.6	0.28	X5	3.6
11.	1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12.	Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.058	X5	2.1
13.	Toluene	18.0	92 (78)	91 (100)	3.6	0.17	X5	3.1
14.	Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15.	Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16.	d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	0.63	X5	54
17.	d_6-Benzene	11.3	84 (100)		1.6	8.28	X5	66
18.	d_8-Toluene	18.0	100 (78)	98 (100)	2.7	4.84	X5	65

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5136
FRN: 14737 CRN: 148

(1) Date Analyzed: 3/14/80 Analyst: PHL
(2) Date Analyzed: 3/24/80 Analyst: JEH

I.S. Ratio: 2.1
Sample Size: 1 mℓ

	Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	CIS/RF	Ax/An	Conc. Factor	Conc. (μg/ℓ)
1.	Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	ND		
2.	Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3.	1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4.	Chloroform	5.0	83 (100)	85 (66)	5.5			4900*
5.	1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6.	1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7.	Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.014	X5	5.3
8.	Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.13	X5	4.0
9.	Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10.	Benzene	11.3	78 (100)		2.6	0.21	X5	2.7
11.	1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12.	Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	ND		
13.	Toluene	18.0	92 (78)	91 (100)	3.6	0.25	X5	4.5
14.	Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15.	Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16.	d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	0.61	X5	52
17.	d_6-Benzene	11.3	84 (100)		1.6	5.0	X5	40
18.	d_8-Toluene	18.0	100 (78)	98 (100)	2.7	3.5	X5	47

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5137
FRN: 14739 CRN: 156

(1) Date Analyzed: 3/14/80 Analyst: PHL
(2) Date Analyzed: 3/24/80 Analyst: JEH

I.S. Ratio: 2.1
Sample Size: 1 mℓ

Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	CIS/RF	Ax/An	Conc. Factor	Conc. (μg/ℓ)
1. Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	ND		
2. Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3. 1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4. Chloroform	5.0	83 (100)	85 (66)	5.5			7400*
5. 1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6. 1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7. Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.012	X5	4.7
8. Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.12	X5	3.7
9. Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10. Benzene	11.3	78 (100)		2.6	0.17	X5	2.2
11. 1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12. Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	ND		
13. Toluene	18.0	92 (78)	91 (100)	3.6	0.17	X5	3.1
14. Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15. Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16. d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	0.61	X5	52
17. d_6-Benzene	11.3	84 (100)		1.6	5.1	X5	41
18. d_8-Toluene	18.0	100 (78)	98 (100)	2.7	3.4	X5	46

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5138
FRN: 14724 CRN: 146

(1) Date Analyzed: 3/13/80 Analyst: PHL
(2) Date Analyzed: 3/15/80 Analyst: JEH

I.S. Ratio: 3.1
Sample Size: 5 mℓ

	Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	CIS/RF	Ax/An	Conc. Factor	Conc. (μg/ℓ)
1.	Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	ND		
2.	Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3.	1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4.	Chloroform	5.0	83 (100)	85 (66)	5.5			3400*
5.	1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6.	1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7.	Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.041	X1	3.1
8.	Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.94	X1	5.7
9.	Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10.	Benzene	11.3	78 (100)		2.6	0.23	X1	<1
11.	1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12.	Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.31	X1	2.3
13.	Toluene	18.0	92 (78)	91 (100)	3.6	0.32	X1	1.2
14.	Chlorobenzene	19.0	112 (100)	114 (33)	2.6	0.30	X1	<1
15.	Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16.	d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	NOT SPIKED		
17.	d_6-Benzene	11.3	84 (100)		1.6	NOT SPIKED		
18.	d_8-Toluene	18.0	100 (78)	98 (100)	2.7	NOT SPIKED		

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5156
FRN: 14827 CRN: 180

(1) Date Analyzed: 3/24/80 Analyst: LDG
(2) Date Analyzed: 3/24/80 Analyst: CFM

I.S. Ratio: 2.2
Sample Size: 1 mℓ

Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	CIS/RF	Ax/An	Conc. Factor	Conc. (μg/ℓ)
1. Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	0.35	X5	4.6
2. Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3. 1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4. Chloroform	5.0	83 (100)	85 (66)	5.5			7000*
5. 1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6. 1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7. Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.018	X5	6.9
8. Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.083	X5	2.5
9. Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10. Benzene	11.3	78 (100)		2.6	0.41	X5	5.3
11. 1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12. Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.059	X5	2.2
13. Toluene	18.0	92 (78)	91 (100)	3.6	0.19	X5	3.4
14. Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15. Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16. d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	0.60	X5	51
17. d_6-Benzene	11.3	84 (100)		1.6	6.6	X5	53
18. d_8-Toluene	18.0	100 (78)	98 (100)	2.7	3.3	X5	45

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5157	(1) Date Analyzed:	3/24/80	Analyst: PHL	I.S. Ratio:	2.4
FRN: 14823 CRN: 180	(2) Date Analyzed:	3/30/80	Analyst: CFM	Sample Size:	1 mℓ

Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	CIS / RF	Ax / An	Conc. Factor	Conc. (μg/ℓ)
1. Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	0.072	X5	< 1
2. Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3. 1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4. Chloroform	5.0	83 (100)	85 (66)	5.5			7600*
5. 1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6. 1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7. Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.02	X5	7.6
8. Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.17	X5	5.2
9. Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10. Benzene	11.3	78 (100)		2.6	0.23	X5	3.0
11. 1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12. Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.083	X5	3.0
13. Toluene	18.0	92 (78)	91 (100)	3.6	0.17	X5	3.0
14. Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15. Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16. d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	0.625	X5	53
17. d_6-Benzene	11.3	84 (100)		1.6	7.22	X5	58
18. d_8-Toluene	18.0	100 (78)	98 (100)	2.7	4.52	X5	61

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5158
FRN: 14816 CRN: 171

(1) Date Analyzed: 3/23/80 Analyst: PHL
(2) Date Analyzed: 3/30/80 Analyst: CFM

I.S. Ratio: 3.1
Sample Size: 1 mℓ

	Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	$\frac{\text{CIS}}{\text{RF}}$	$\frac{\text{Ax}}{\text{An}}$	Conc. Factor	Conc. (μg/ℓ)
1.	Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	0.01	X5	<1
2.	Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3.	1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4.	Chloroform	5.0	83 (100)	85 (66)	5.5			4800*
5.	1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6.	1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7.	Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	ND		
8.	Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.10	X5	3.1
9.	Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10.	Benzene	11.3	78 (100)		2.6	0.24	X5	3.1
11.	1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12.	Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.79	X5	2.9
13.	Toluene	18.0	92 (78)	91 (100)	3.6	0.27	X5	4.9
14.	Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15.	Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16.	d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	0.59	X5	50
17.	d_6-Benzene	11.3	84 (100)		1.6	8.9	X5	71
18.	d_8-Toluene	18.0	100 (78)	98 (100)	2.7	5.2	X5	70

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5159
FRN: 14741 CRN: 156

(1) Date Analyzed: 3/14/80 Analyst: PHL
(2) Date Analyzed: 3/24/80 Analyst: JEH

I.S. Ratio: 2.1
Sample Size: 1 mℓ

	Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	$\frac{\text{CIS}}{\text{RF}}$	$\frac{\text{Ax}}{\text{An}}$	Conc. Factor	Conc. (μg/ℓ)
1.	Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	0.060	X5	<1
2.	Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3.	1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4.	Chloroform	5.0	83 (100)	85 (66)	5.5			6000*
5.	1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6.	1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7.	Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.014	X5	5.3
8.	Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.13	X5	4.0
9.	Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10.	Benzene	11.3	78 (100)		2.6	0.20	X5	2.6
11.	1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12.	Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	ND		
13.	Toluene	18.0	92 (78)	91 (100)	3.6	0.23	X5	4.1
14.	Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15.	Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16.	d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	0.75	X5	64
17.	d_6-Benzene	11.3	84 (100)		1.6	6.2	X5	50
18.	d_8-Toluene	18.0	100 (78)	98 (100)	2.7	3.9	X5	53

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5160
FRN: 14728 CRN: 143

(1) Date Analyzed: 3/13/80 Analyst: PHL
(2) Date Analyzed: 3/15/80 Analyst: JEH

I.S. Ratio: 3.1
Sample Size: 5 mℓ

	Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	CIS/RF	Ax/An	Conc. Factor	Conc. (μg/ℓ)
1.	Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	1.1	X1	2.9
2.	Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3.	1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4.	Chloroform	5.0	83 (100)	85 (66)	5.5			3700*
5.	1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6.	1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7.	Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.065	X1	4.9
8.	Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.80	X1	4.9
9.	Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10.	Benzene	11.3	78 (100)		2.6	0.21	X1	<1
11.	1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12.	Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.28	X1	2.1
13.	Toluene	18.0	92 (78)	91 (100)	3.6	0.43	X1	1.5
14.	Chlorobenzene	19.0	112 (100)	114 (33)	2.6	0.23	X1	<1
15.	Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16.	d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	NOT	SPIKED	
17.	d_6-Benzene	11.3	84 (100)		1.6	NOT	SPIKED	
18.	d_8-Toluene	18.0	100 (78)	98 (100)	2.7	NOT	SPIKED	

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5143
FRN: 14776 CRN: 151

(1) Date Analyzed: 3/30/80 Analyst: LDG
(2) Date Analyzed: 4/02/80 Analyst: RLS

I.S. Ratio: 1.9
Sample Size: 1 mℓ

Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	CIS/RF	Ax/An	Conc. Factor	Conc. (µg/ℓ)
1. Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	ND		
2. Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3. 1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4. Chloroform	5.0	83 (100)	85 (66)	5.5			5500*
5. 1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6. 1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7. Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.027	X5	10
8. Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.24	X5	7.3
9. Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10. Benzene	11.3	78 (100)		2.6	ND		
11. 1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12. Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.10	X5	3.7
13. Toluene	18.0	92 (78)	91 (100)	3.6	0.37	X5	6.7
14. Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15. Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16. d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	1.1	X5	94
17. d_6-Benzene	11.3	84 (100)		1.6	9.7	X5	81
18. d_8-Toluene	18.0	100 (78)	98 (100)	2.7	5.9	X5	77

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5144 FRN: 14767 CRN: 153	(1) Date Analyzed: 3/18/80 (2) Date Analyzed: 3/30/80	Analyst: PHL Analyst: JEH	I.S. Ratio: 2.6 Sample Size: 1 mℓ

	Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	CIS/RF	Ax/An	Conc. Factor	Conc. (μg/ℓ)
1.	Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	ND		
2.	Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3.	1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4.	Chloroform	5.0	83 (100)	85 (66)	5.5			5000*
5.	1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6.	1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7.	Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	ND		
8.	Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.17	X5	5.2
9.	Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10.	Benzene	11.3	78 (100)		2.6	0.30	X5	3.9
11.	1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12.	Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.11	X5	4.1
13.	Toluene	18.0	92 (78)	91 (100)	3.6	0.11	X5	2.0
14.	Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15.	Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16.	d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	0.47	X5	40
17.	d_6-Benzene	11.3	84 (100)		1.6	6.6	X5	53
18.	d_8-Toluene	18.0	100 (78)	98 (100)	2.7	3.9	X5	53

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5145
FRN: 14769 CRN: 152

(1) Date Analyzed: 3/18/80 Analyst: PHL
(2) Date Analyzed: 3/28/80 Analyst: JEH

I.S. Ratio: 2.3
Sample Size: 1 mℓ

	Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	CIS/RF	Ax/An	Conc. Factor	Conc. (μg/ℓ)
1.	Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	ND		
2.	Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3.	1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4.	Chloroform	5.0	83 (100)	85 (66)	5.5			6100*
5.	1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6.	1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7.	Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.020	X5	7.6
8.	Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.17	X5	5.2
9.	Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10.	Benzene	11.3	78 (100)		2.6	0.22	X5	2.9
11.	1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12.	Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.070	X5	2.6
13.	Toluene	18.0	92 (78)	91 (100)	3.6	0.32	X5	5.8
14.	Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15.	Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16.	d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	0.53	X5	45
17.	d_6-Benzene	11.3	84 (100)		1.6	5.4	X5	43
18.	d_8-Toluene	18.0	100 (78)	98 (100)	2.7	3.7	X5	50

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5146
FRN: 14774 CRN: 152

(1) Date Analyzed: 3/18/80 Analyst: LDG
(2) Date Analyzed: 3/28/80 Analyst: JEH

I.S. Ratio: 2.3
Sample Size: 1 mℓ

	Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	CIS/RF	Ax/An	Conc. Factor	Conc. (µg/ℓ)
1.	Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	0.022	X5	<1
2.	Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3.	1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4.	Chloroform	5.0	83 (100)	85 (66)	5.5			6800*
5.	1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6.	1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7.	Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.014	X5	5.3
8.	Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.12	X5	3.7
9.	Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10.	Benzene	11.3	78 (100)		2.6	ND		
11.	1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12.	Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.045	X5	1.7
13.	Toluene	18.0	92 (78)	91 (100)	3.6	0.16	X5	2.9
14.	Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15.	Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16.	d$_4$-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	0.56	X5	48
17.	d$_6$-Benzene	11.3	84 (100)		1.6	6.0	X5	48
18.	d$_8$-Toluene	18.0	100 (78)	98 (100)	2.7	3.4	X5	46

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5147
FRN: 14764 CRN: 153

(1) Date Analyzed: 3/17/80 Analyst: LDG
(2) Date Analyzed: 3/28/80 Analyst: JEH

I.S. Ratio: 2.1
Sample Size: 1 mℓ

	Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	CIS/RF	Ax/An	Conc. Factor	Conc. (µg/ℓ)
1.	Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	ND		
2.	Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3.	1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4.	Chloroform	5.0	83 (100)	85 (66)	5.5			7600*
5.	1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6.	1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7.	Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.026	X5	9.9
8.	Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.20	X5	6.1
9.	Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10.	Benzene	11.3	78 (100)		2.6	0.24	X5	3.1
11.	1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12.	Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.061	X5	2.3
13.	Toluene	18.0	92 (78)	91 (100)	3.6	0.11	X5	2.0
14.	Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15.	Ethylbedzene	21.4	106 (33)	91 (100)	6.5	ND		
16.	d$_4$-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	0.61	X5	52
17.	d$_6$-Benzene	11.3	84 (100)		1.6	6.2	X5	50
18.	d$_8$-Toluene	18.0	100 (78)	98 (100)	2.7	3.6	X5	49

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5148
FRN: 14771 CRN: 152

(1) Date Analyzed: 3/18/80 Analyst: PHL
(2) Date Analyzed: 3/28/80 Analyst: JEH

I.S. Ratio: 2.4
Sample Size: 5 mℓ

	Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	CIS/RF	Ax/An	Conc. Factor	Conc. (µg/ℓ)
1.	Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	0.058	X1	<1
2.	Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3.	1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4.	Chloroform	5.0	83 (100)	85 (66)	5.5			4000*
5.	1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6.	1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7.	Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.067	X1	5.1
8.	Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.42	X1	2.6
9.	Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10.	Benzene	11.3	78 (100)		2.6	0.42	X1	1.1
11.	1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12.	Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.32	X1	2.4
13.	Toluene	18.0	92 (78)	91 (100)	3.6	0.68	X1	2.4
14.	Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15.	Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16.	d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	2.5	X1	43
17.	d_6-Benzene	11.3	84 (100)		1.6	30	X1	48
18.	d_8-Toluene	18.0	100 (78)	98 (100)	2.7	17	X1	46

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5149
FRN: 14778 CRN: 151

(1) Date Analyzed: 3/30/80 Analyst: LDG
(2) Date Analyzed: 4/02/80 Analyst: RLS

I.S. Ratio: 2.7
Sample Size: 1 mℓ

Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	CIS/RF	Ax/An	Conc. Factor	Conc. (µg/ℓ)
1. Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	ND		
2. Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3. 1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4. Chloroform	5.0	83 (100)	85 (66)	5.5			3700*
5. 1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6. 1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7. Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.016	X5	6.1
8. Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.21	X5	6.4
9. Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10. Benzene	11.3	78 (100)		2.6	0.17	X5	2.2
11. 1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12. Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.14	X5	5.2
13. Toluene	18.0	92 (78)	91 (100)	3.6	0.19	X5	3.4
14. Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15. Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16. d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	0.59	X5	50
17. d_6-Benzene	11.3	84 (100)		1.6	8.1	X5	65
18. d_8-Toluene	18.0	100 (78)	98 (100)	2.7	4.6	X5	62

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5150
FRN: 14791 CRN: 150

(1) Date Analyzed: 3/19/80 Analyst: LDC
(2) Date Analyzed: 3/30/80 Analyst: JEH

I.S. Ratio: 2.2
Sample Size: 1 ml

	Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	CIS/RF	Ax/An	Conc. Factor	Conc. (μg/ℓ)
1.	Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	ND		
2.	Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3.	1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4.	Chloroform	5.0	83 (100)	85 (66)	5.5			28000*
5.	1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6.	1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7.	Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	ND		
8.	Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	2.7	X5	82
9.	Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10.	Benzene	11.3	78 (100)		2.6	ND		
11.	1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12.	Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.90	X5	3.3
13.	Toluene	18.0	92 (78)	91 (100)	3.6	0.29	X5	5.2
14.	Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15.	Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16.	d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	0.54	X5	46
17.	d_6-Benzene	11.3	84 (100)		1.6	7.0	X5	56
18.	d_8-Toluene	18.0	100 (78)	98 (100)	2.7	3.9	X5	53

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5151
FRN: 14780 CRN: 151

(1) Date Analyzed: 3/18/80 Analyst: LDC
(2) Date Analyzed: 3/20/80 Analyst: JEB

I.S. Ratio: 2.5
Sample Size: 1 ml

	Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	CIS/RF	Ax/As	Conc. Factor	Conc. (μg/l)
1.	Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	ND		
2.	Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3.	1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4.	Chloroform	5.0	83 (100)	85 (66)	5.5			6600*
5.	1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6.	1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7.	Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.040	85	15
8.	Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.13	85	6.0
9.	Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10.	Benzene	11.3	78 (100)		2.6	0.25	85	3.3
11.	1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.0	ND		
12.	Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (66)	7.4	0.11	85	4.1
13.	Toluene	18.0	92 (78)	91 (100)	3.6	0.23	85	4.1
14.	Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15.	Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16.	d_4-1,2-Dichloroethane	6.0	67 (100)	69 (33)	17.0	0.61	85	52
17.	d_6-Benzene	11.3	84 (100)		1.6	7.6	85	61
18.	d_8-Toluene	18.0	100 (78)	98 (100)	2.7	5.1	85	69

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5152
FRN: 14783 CRN: 151

(1) Date Analyzed: 3/19/80 Analyst: PHL
(2) Date Analyzed: 3/30/80 Analyst: JEH

I.S. Ratio: 2.3
Sample Size: 1 mℓ

	Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	CIS/RF	Ax/An	Conc. Factor	Conc. (μg/ℓ)
1.	Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	ND		
2.	Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3.	1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4.	Chloroform	5.0	83 (100)	85 (66)	5.5			6000*
5.	1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6.	1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7.	Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.014	X5	5.3
8.	Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.16	X5	4.9
9.	Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10.	Benzene	11.3	78 (100)		2.6	0.19	X5	2.5
11.	1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12.	Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.10	X5	3.7
13.	Toluene	18.0	92 (78)	91 (100)	3.6	0.37	X5	6.7
14.	Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15.	Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16.	d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	0.64	X5	54
17.	d_6-Benzene	11.3	84 (100)		1.6	7.3	X5	58
18.	d_8-Toluene	18.0	100 (78)	98 (100)	2.7	4.3	X5	58

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5153	(1) Date Analyzed: 3/19/80	Analyst: PHL	I.S. Ratio: 2.8
FRN: 14787 CRN: 150	(2) Date Analyzed: 3/30/80	Analyst: JEH	Sample Size: 1 mℓ

	Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	CIS/RF	Ax/An	Conc. Factor	Conc. (μg/ℓ)
1.	Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	0.13	X5	1.7
2.	Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3.	1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4.	Chloroform	5.0	83 (100)	85 (66)	5.5			7500*
5.	1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6.	1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7.	Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.039	X5	15
8.	Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.13	X5	4.0
9.	Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10.	Benzene	11.3	78 (100)		2.6	0.17	X5	2.2
11.	1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12.	Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.11	X5	4.1
13.	Toluene	18.0	92 (78)	91 (100)	3.6	0.14	X5	2.5
14.	Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15.	Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16.	d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	0.49	X5	42
17.	d_6-Benzene	11.3	84 (100)		1.6	7.0	X5	56
18.	d_8-Toluene	18.0	100 (78)	98 (100)	2.7	4.5	X5	61

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5154
FRN: 14789 CRN: 150

(1) Date Analyzed: 3/19/80 Analyst: LDG
(2) Date Analyzed: 3/30/80 Analyst: JEH

I.S. Ratio: 2.4
Sample Size: 1 mℓ

	Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	$\frac{CIS}{RF}$	$\frac{Ax}{An}$	Conc. Factor	Conc. (μg/ℓ)
1.	Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	0.018	X5	<1
2.	Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3.	1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4.	Chloroform	5.0	83 (100)	85 (66)	5.5			7600*
5.	1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6.	1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7.	Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.018	X5	6.8
8.	Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.18	X5	5.5
9.	Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10.	Benzene	11.3	78 (100)		2.6	ND		
11.	1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12.	Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.084	X5	3.1
13.	Toluene	18.0	92 (78)	91 (100)	3.6	0.25	X5	4.5
14.	Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15.	Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16.	d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	0.53	X5	45
17.	d_6-Benzene	11.3	84 (100)		1.6	7.0	X5	56
18.	d_8-Toluene	18.0	100 (78)	98 (100)	2.7	4.1	X5	55

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5155
FRN: 14785 CRN: 150

(1) Date Analyzed: 3/19/80 Analyst: PHL
(2) Date Analyzed: 3/30/80 Analyst: JEH

I.S. Ratio: 3.0
Sample Size: 1 mℓ

	Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	$\frac{\text{CIS}}{\text{RF}}$	$\frac{\text{Ax}}{\text{An}}$	Conc. Factor	Conc. (μg/ℓ)
1.	Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	0.032	X5	<1
2.	Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3.	1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4.	Chloroform	5.0	83 (100)	85 (66)	5.5			6600*
5.	1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6.	1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7.	Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.012	X5	4.6
8.	Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.24	X5	7.3
9.	Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10.	Benzene	11.3	78 (100)		2.6	0.20	X5	2.6
11.	1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12.	Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.087	X5	3.2
13.	Toluene	18.0	92 (78)	91 (100)	3.6	0.19	X5	3.4
14.	Chlorobenzene	19.0	112 (100)	114 (33)	2.6	0.10	X5	1.3
15.	Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16.	d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	0.50	X5	43
17.	d_6-Benzene	11.3	84 (100)		1.6	7.9	X5	63
18.	d_8-Toluene	18.0	100 (78)	98 (100)	2.7	4.6	X5	57

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5161
FRN: 14762 CRN: 153

(1) Date Analyzed: 3/17/80 Analyst: LDG
(2) Date Analyzed: 3/28/80 Analyst: JEH

I.S. Ratio: 2.3
Sample Size: 1 mℓ

Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	CIS/RF	Ax/An	Conc. Factor	Conc. (μg/ℓ)
1. Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	ND		
2. Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3. 1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4. Chloroform	5.0	83 (100)	85 (66)	5.5			8100*
5. 1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6. 1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7. Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.016	X5	6.1
8. Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.072	X5	2.2
9. Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10. Benzene	11.3	78 (100)		2.6	0.14	X5	1.8
11. 1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12. Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.093	X5	3.4
13. Toluene	18.0	92 (78)	91 (100)	3.6	0.18	X5	3.2
14. Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15. Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16. d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	0.51	X5	43
17. d_6-Benzene	11.3	84 (100)		1.6	5.9	X5	47
18. d_8-Toluene	18.0	100 (78)	98 (100)	2.7	3.4	X5	46

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5162
FRN: 14744 CRN: 156

(1) Date Analyzed: 3/15/80 Analyst: LDG
(2) Date Analyzed: 3/30/80 Analyst: JEH

I.S. Ratio: 2.0
Sample Size: 1 mℓ

	Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	CIS/RF	Ax/An	Conc. Factor	Conc. (μg/ℓ)
1.	Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	ND		
2.	Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3.	1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4.	Chloroform	5.0	83 (100)	85 (66)	5.5			8400*
5.	1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6.	1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7.	Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.034	X5	13
8.	Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.18	X5	5.5
9.	Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10.	Benzene	11.3	78 (100)		2.6	0.27	X5	3.5
11.	1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12.	Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.086	X5	3.2
13.	Toluene	18.0	92 (78)	91 (100)	3.6	0.20	X5	3.6
14.	Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15.	Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16.	d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	0.76	X5	65
17.	d_6-Benzene	11.3	84 (100)		1.6	6.6	X5	53
18.	d_8-Toluene	18.0	100 (78)	98 (100)	2.7	4.5	X5	61

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5163
FRN: 14746 CRN: 156

(1) Date Analyzed: 3/18/80 Analyst: PHL
(2) Date Analyzed: 3/30/80 Analyst: JEH

I.S. Ratio: 2.1
Sample Size: 1 mℓ

	Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	CIS/RF	Ax/An	Conc. Factor	Conc. (μg/ℓ)
1.	Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	ND		
2.	Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3.	1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4.	Chloroform	5.0	83 (100)	85 (66)	5.5			5400*
5.	1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6.	1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7.	Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.016	X5	6.1
8.	Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.13	X5	4.0
9.	Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10.	Benzene	11.3	78 (100)		2.6	0.21	X5	2.7
11.	1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12.	Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.074	X5	2.7
13.	Toluene	18.0	92 (78)	91 (100)	3.6	0.21	X5	3.8
14.	Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15.	Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16.	d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	0.84	X5	71
17.	d_6-Benzene	11.3	84 (100)		1.6	6.9	X5	55
18.	d_8-Toluene	18.0	100 (78)	98 (100)	2.7	4.2	X5	57

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5164
FRN: 14748 CRN: 155

(1) Date Analyzed: 3/15/80 Analyst: LDG
(2) Date Analyzed: 3/28/80 Analyst: JEH

I.S. Ratio: 2.4
Sample Size: 1 mℓ

	Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	$\frac{CIS}{RF}$	$\frac{Ax}{An}$	Conc. Factor	Conc. (µg/ℓ)
1.	Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	ND		
2.	Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3.	1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4.	Chloroform	5.0	83 (100)	85 (66)	5.5			7300*
5.	1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6.	1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7.	Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.023	X5	8.9
8.	Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.12	X5	3.7
9.	Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10.	Benzene	11.3	78 (100)		2.6	ND		
11.	1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12.	Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.081	X5	3.0
13.	Toluene	18.0	92 (78)	91 (100)	3.6	0.18	X5	3.2
14.	Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15.	Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16.	d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	0.78	X5	66
17.	d_6-Benzene	11.3	84 (100)		1.6	7.3	X5	58
18.	d_8-Toluene	18.0	100 (78)	98 (100)	2.7	4.5	X5	61

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5165
FRN: 14751 CRN: 155

(1) Date Analyzed: 3/16/80 Analyst: PHL
(2) Date Analyzed: 3/28/80 Analyst: JEH

I.S. Ratio: 2.4
Sample Size: 1 mℓ

Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	$\frac{\text{CIS}}{\text{RF}}$	$\frac{\text{Ax}}{\text{An}}$	Conc. Factor	Conc. (µg/ℓ)
1. Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	ND		
2. Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3. 1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4. Chloroform	5.0	83 (100)	85 (66)	5.5			5200*
5. 1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6. 1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7. Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.017	X5	6.4
8. Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.12	X5	3.7
9. Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10. Benzene	11.3	78 (100)		2.6	0.24	X5	3.1
11. 1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12. Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.061	X5	2.3
13. Toluene	18.0	92 (78)	91 (100)	3.6	0.20	X5	3.6
14. Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15. Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16. d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	0.75	X5	64
17. d_6-Benzene	11.3	84 (100)		1.6	7.0	X5	56
18. d_8-Toluene	18.0	100 (78)	98 (100)	2.7	4.4	X5	59

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5166
FRN: 14753 CRN: 155

(1) Date Analyzed: 3/16/80 Analyst: PHL
(2) Date Analyzed: 3/28/80 Analyst: JEH

I.S. Ratio: 3.0
Sample Size: 1 mℓ

	Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	CIS/RF	Ax/An	Conc. Factor	Conc. (μg/ℓ)
1.	Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	ND		
2.	Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3.	1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4.	Chloroform	5.0	83 (100)	85 (66)	5.5			9200*
5.	1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6.	1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7.	Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.019	X5	7.2
8.	Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.13	X5	4.0
9.	Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10.	Benzene	11.3	78 (100)		2.6	0.33	X5	4.3
11.	1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12.	Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.038	X5	1.4
13.	Toluene	18.0	92 (78)	91 (100)	3.6	0.19	X5	3.4
14.	Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15.	Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16.	d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	0.68	X5	58
17.	d_6-Benzene	11.3	84 (100)		1.6	7.9	X5	63
18.	d_8-Toluene	18.0	100 (78)	98 (100)	2.7	5.1	X5	69

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5167
FRN: 14755 CRN: 155

(1) Date Analyzed: 3/16/80 Analyst: PHL
(2) Date Analyzed: 3/28/80 Analyst: JEH

I.S. Ratio: 2.9
Sample Size: 1 mℓ

Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	CIS/RF	Ax/An	Conc. Factor	Conc. (μg/ℓ)
1. Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	0.041	X5	<1
2. Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3. 1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4. Chloroform	5.0	83 (100)	85 (66)	5.5			6700*
5. 1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6. 1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7. Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.016	X5	5.9
8. Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.17	X5	5.2
9. Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10. Benzene	11.3	78 (100)		2.6	0.21	X5	2.7
11. 1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12. Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	ND		
13. Toluene	18.0	92 (78)	91 (100)	3.6	0.21	X5	3.8
14. Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15. Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16. d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	0.69	X5	59
17. d_6-Benzene	11.3	84 (100)		1.6	7.5	X5	60
18. d_8-Toluene	18.0	100 (78)	98 (100)	2.7	4.3	X5	58

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5168
FRN: 14757 CRN: 155

(1) Date Analyzed: 3/16/80 Analyst: PHL
(2) Date Analyzed: 3/28/80 Analyst: JEH

I.S. Ratio: 2.8
Sample Size: 5 mℓ

	Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	CIS/RF	Ax/An	Conc. Factor	Conc. (μg/ℓ)
1.	Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	0.16	X1	<1
2.	Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3.	1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4.	Chloroform	5.0	83 (100)	85 (66)	5.5			4000*
5.	1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6.	1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7.	Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.050	X1	3.8
8.	Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.48	X1	2.9
9.	Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10.	Benzene	11.3	78 (100)		2.6	0.48	X1	1.2
11.	1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12.	Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.37	X1	2.7
13.	Toluene	18.0	92 (78)	91 (100)	3.6	0.98	X1	3.5
14.	Chlorobenzene	19.0	112 (100)	114 (33)	2.6	0.20	X1	<1
15.	Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16.	d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	3.1	X1	53
17.	d_6-Benzene	11.3	84 (100)		1.6	31	X1	50
18.	d_8-Toluene	18.0	100 (78)	98 (100)	2.7	18	X1	49

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 5169	(1) Date Analyzed: 3/17/80	Analyst: LDG	I.S. Ratio: 2.4
FRN: 14760 CRN: 153	(2) Date Analyzed: 3/28/80	Analyst: JEH	Sample Size: 1 mℓ

	Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	CIS/RF	Ax/An	Conc. Factor	Conc. (μg/ℓ)
1.	Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	0.059	X5	<1
2.	Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3.	1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4.	Chloroform	5.0	83 (100)	85 (66)	5.5			6400*
5.	1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6.	1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7.	Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.043	X5	16
8.	Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.23	X5	7.0
9.	Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10.	Benzene	11.3	78 (100)		2.6	0.19	X5	2.5
11.	1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12.	Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	ND		
13.	Toluene	18.0	92 (78)	91 (100)	3.6	0.14	X5	2.5
14.	Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15.	Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16.	d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	ND		
17.	d_6-Benzene	11.3	84 (100)		1.6	3.8	X5	30
18.	d_8-Toluene	18.0	100 (78)	98 (100)	2.7	ND		

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 4979	(1) Date Analyzed: 3/13/80	Analyst: LDG	I.S. Ratio: 3.0
FRN: 14722 CRN: 143	(2) Date Analyzed: 3/16/80	Analyst: CPM	Sample Size: 2.5 mℓ

	Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	CIS / RF	Ax / Ac	Conc. Factor	Conc. (µg/ℓ)
1.	Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	ND		
2.	Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3.	1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4.	Chloroform	5.0	83 (100)	85 (66)	5.5			9200*
5.	1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6.	1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7.	Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.036	X2	<1
8.	Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.41	X2	4.9
9.	Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10.	Benzene	11.3	78 (100)		2.6	0.21	X2	1.1
11.	1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12.	Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.12	X2	1.8
13.	Toluene	18.0	92 (78)	91 (100)	3.6	0.18	X2	1.3
14.	Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15.	Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16.	d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17.0	NOT	SPIKED	
17.	d_6-Benzene	11.3	84 (100)		1.6	NOT	SPIKED	
18.	d_8-Toluene	18.0	100 (78)	98 (100)	2.7	NOT	SPIKED	

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 4978
FRN: 14720 CRN: 146

(1) Date Analyzed: 3/13/80 Analyst: LDG
(2) Date Analyzed: 3/16/80 Analyst: CFM

I.S. Ratio: 3.0
Sample Size: 5 mℓ

Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	CIS/RF	Ax/An	Conc. Factor	Conc. (μg/ℓ)
1. Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	0.10	X1	<1
2. Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3. 1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	ND		
4. Chloroform	5.0	83 (100)	85 (66)	5.5			4600*
5. 1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	0.011	X1	1.4
6. 1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7. Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.042	X1	3.2
8. Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.82	X1	5.0
9. Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10. Benzene	11.3	78 (100)		2.6	0.27	X1	ND
11. 1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12. Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.35	X1	2.6
13. Toluene	18.0	92 (78)	91 (100)	3.6	0.52	X1	1.9
14. Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15. Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16. d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17	NOT SPIKED		
17. d_6-Benzene	11.3	84 (100)		1.6	NOT SPIKED		
18. d_8-Toluene	18.0	100 (78)	98 (100)	2.7	NOT SPIKED		

*Done by direct injection.

PRIORITY POLLUTANT ANALYTICAL REPORT: PURGEABLES
SWEDISH ION EXCHANGE TECHNOLOGY

Sample Number: 4980
FRN: 14718 CRN: 134

(1) Date Analyzed: 3/13/80 Analyst: LDG
(2) Date Analyzed: 3/16/80 Analyst: CFM

I.S. Ratio: 3.7
Sample Size: 5 mℓ

	Compound	Retention Time (Minutes)	Quantitative Ion (Percent of Base Peak)	Secondary (Ions) (Percent of Base Peak)	$\frac{CIS}{RF}$	$\frac{Ax}{An}$	Conc. Factor	Conc. ($\mu g/\ell$)
1.	Methylene chloride	1.8	84 (86)	49 (100), 86 (55)	2.6	ND		
2.	Trichlorofluoromethane	2.5	101 (100)	103 (66)	79.	ND		
3.	1,1-Dichloroethane	3.7	63 (100)	65 (33), 98 (7)	9.0	0.07	X1	<1
4.	Chloroform	5.0	83 (100)	85 (66)	5.5	7.1	X1	39
5.	1,2-Dichloroethane	6.0	98 (23)	62 (100), 64 (33)	130.	ND		
6.	1,1,1-Trichloroethane	6.7	97 (100)	99 (66), 117 (17)	12.	ND		
7.	Bromodichloromethane	8.1	127 (13)	83 (100), 85 (66)	76.	0.033	X1	2.5
8.	Trichloroethylene	10.7	130 (90)	95 (100), 97 (66)	6.1	0.80	X1	4.9
9.	Dibromochloromethane	11.1	127 (78)	129 (100), 208 (13)	4.9	ND		
10.	Benzene	11.3	78 (100)		2.6	0.18	X1	<1
11.	1,1,2,2-Tetrachloroethane	16.1	83 (100)	85 (66), 131 (7)	5.8	ND		
12.	Tetrachloroethylene	16.7	164 (78)	166 (100), 129 (64)	7.4	0.22	X1	1.6
13.	Toluene	18.0	92 (78)	91 (100)	3.6	ND		
14.	Chlorobenzene	19.0	112 (100)	114 (33)	2.6	ND		
15.	Ethylbenzene	21.4	106 (33)	91 (100)	6.5	ND		
16.	d_4-1,4-Dichloroethane	6.0	67 (100)	69 (33)	17	NOT	SPIKED	
17.	d_6-Benzene	11.3	84 (100)		1.6	NOT	SPIKED	
18.	d_8-Toluene	18.0	100 (78)	98 (100)	2.7	NOT	SPIKED	

20 μg spike
0.925ℓ sample

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY

Sample Number: 5067
FRN: 25284[177]   Date Analyzed: 4/12/80   Analyst: PHL

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	$\frac{Ax}{Ais}$	$\frac{Cis}{RF}$	Conc. Factor	Conc. (μg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)	0.034	247	1.08	9.1
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.067	297	1.08	22
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)	0.024	172	1.08	4.4*
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	0.16	292	1.08	51
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.076	192	1.08	16
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.24	43	1.08	11
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)	0.048	654	1.08	34
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimeric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)	2.0	34	1.08	74
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)		940		
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)	0.52	52	1.08	29
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.26	240	1.08	67
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)	0.69	82	1.08	61
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)	0.23	107	1.08	27
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.13	139	1	18
d_8-Naphthalene	12.1	136 (100)	137 (11)	0.38	3[illegible]	1	12
d_{35}-Stearic acid	29.7	77 (100)	91 (60)	0.019	185	1	3.5
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)	0.069	160	1.08	12

*Possibly another trichlorphenol isomer.
Phenols as methyl ethers; fatty acids as methyl esters.

10 μg spike
0.93 ℓ sample

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY

Sample Number: 5068
FRN: 25285
Date Analyzed: 4/6/80 Analyst: PHL

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	Ax / Ais	Cis / RF	Conc. Factor	Conc. (μg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)		247		
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.0041	297	1.08	1.3
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)		172		
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	0.058	292	1.08	18
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.079	192	1.08	16
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.15	43	1.08	7.0
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)	0.014	654	1.08	10
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimeric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)	0.20	34	1.08	7.3
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)	0.039	940	1.08	40
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)	0.097	52	1.08	5.4
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.069	240	1.08	18
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)	0.14	82	1.08	12
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)	0.11	107	1.08	13
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.054	139	1	7.5
d_8-Naphthalene	12.1	136 (100)	137 (11)	0.20	32	1	6.4
d_{35}-Stearic acid	29.7	77 (100)	91 (60)		185		
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)	0.032	160	1.08	5.5

Phenols as methyl ethers; fatty acids as methyl esters.

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Sample Number: 5069
FRN: 25286[176]

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY
Date Analyzed: 4/12/80 Analyst: PHL

50 µg spike
0.94 ℓ sample

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	Ax/Ais	Cis/RF	Conc. Factor	Conc. (µg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)	0.28	247	1.06	73
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.52	297	1.06	160
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)	0.046	172	1.06	8.4*
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	1.1	292	1.06	340
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.73	192	1.06	150
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.040	43	1.06	1.8
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)	0.13	654	1.06	90
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimeric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)	1.9	34	1.06	69
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)	0.036	940	1.06	36
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)	0.25	52	1.06	14
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.02	240	1.06	5.1
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)	0.32	82	1.06	28
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)	0.081	107	1.06	9.3
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.20	139	1	28
d_8-Naphthalene	12.1	136 (100)	137 (11)	1.0	32	1	32
d_{35}-Stearic acid	29.7	77 (100)	91 (60)	0.012	185	1	2.2
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)	0.11	160	1.06	19

*Possibly another trichlorophenol isomer.
Phenols as methyl ethers; fatty acids as methyl esters.

Sample Number: 5070
FRN: 25287

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY
Date Analyzed: 4/2/80 Analyst: PHL

10 µg spike
0.98 ℓ sample

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	Ax/Ais	Cis/RF	Conc. Factor	Conc. (mg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)		247		
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)		297		
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)		172		
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	0.038	292	1.02	11
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.028	192	1.02	5.4
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.043	43	1.02	1.8
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)	0.043	654	1.02	29
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimeric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)	0.041	34	1.02	1.4
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)	0.073	940	1.02	70
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)	0.23	52	1.02	12
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.025	240	1.02	6.1
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)	0.30	82	1.02	26
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)	0.19	107		
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.056	139	1	7.8
d_8-Naphthalene	12.1	136 (100)	137 (11)	0.18	32	1	5.8
d_{35}-Stearic acid	29.7	77 (100)	91 (60)	0.069	185	1	1.7
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)	0.061	160	1.02	10

Phenols as methyl ethers; fatty acids as methyl esters.

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Sample Number: 5071
FRN: 25289

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY
Date Analyzed: 4/6/80 Analyst: PHL

10 μg spike
0.96 ℓ sample

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	$\frac{Ax}{Ais}$	$\frac{Cis}{RF}$	Conc. Factor	Conc. (μg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)		247		
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.0047	297	1.04	1.5
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)		172		
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	0.039	292	1.04	12
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.026	192	1.04	5.2
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)		43		
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)	0.044	654	1.04	30
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimeric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)	0.62	34	1.04	22
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)		940		
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)	0.33	52	1.04	18
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.013	240	1.04	3.2
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)	0.48	82	1.04	41
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)	0.21	107	1.04	23
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.037	139	1	5.1
d_8-Naphthalene	12.1	136 (100)	137 (11)	0.21	32	1	6.7
d_{35}-Stearic acid	29.7	77 (100)	91 (60)	0.011	185	1	2.0
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)	0.052	160	1.04	8.6

Phenols as methyl ethers; fatty acids as methyl esters.

Sample Number: 5072
FRN: 25290[48]

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY
Date Analyzed: 4/8/80 Analyst: PHL

20 μg spike
0.95 ℓ sample

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	Ax/Ais	Cis/RF	Conc. Factor	Conc. (μg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)	0.0073	247	1.05	1.9
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.016	297	1.05	5.1
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)		172		
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)	0.034	58	1.05	2.1
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	0.061	292	1.05	19
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.036	192	1.05	7.3
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.033	43	1.05	1.5
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)	0.027	654	1.05	1.9
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimeric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)	0.63	34	1.05	22
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)	0.039	940	1.05	39
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)	0.22	52	1.05	12
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.012	240	1.05	3.1
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)	0.28	82	1.05	24
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)	0.075	107	1.05	8.4
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.048	139	1	6.7
d_8-Naphthalene	12.1	136 (100)	137 (11)	0.34	32	1	11
d_{35}-Stearic acid	29.7	77 (100)	91 (60)		185		
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)	0.031	160	1.05	5.3

Phenols as methyl ethers; fatty acids as methyl esters.

Sample Number: 5073
FRN: 25291

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY

Date Analyzed: 4/6/80 Analyst: PHL

20 µg spike
0.97 ℓ sample

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	Ax/Ais	Cis/RF	Conc. Factor	Conc. (µg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)	0.022	247	1.03	5.6
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.079	297	1.03	24
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)	0.022	172	1.03	3.9*
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	0.17	292	1.03	52
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.087	192	1.03	18
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.039	43	1.03	1.8
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)	0.022	654	1.03	14
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimeric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)	1.1	34	1.03	38
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)	0.054	940	1.03	53
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)	0.19	52	1.03	10
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.0095	240	1.03	2.4
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)	0.26	82	1.03	22
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)	0.068	107	1.03	7.5
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.067	139	1	9.3
d_8-Naphthalene	12.1	136 (100)	137 (11)	0.34	32	1	11
d_{35}-Stearic acid	29.7	77 (100)	91 (60)		185		
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)		160		

*Possibly another trichlorophenol isomer.
Phenols as methyl ethers; fatty acids as methyl esters.

Sample Number: 5120
FRN: 25364

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY
Date Analyzed: 4/8/80 Analyst: PHL

50 μg spike
0.65 ℓ sample

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	$\frac{Ax}{Ais}$	$\frac{Cis}{RF}$	Conc. Factor	Conc. (μg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)	0.11	247	1.54	42
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.20	297	1.54	91
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)	0.052	172	1.54	14*
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	0.61	292	1.54	280
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.34	192	1.54	100
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.13	43	1.54	8.6
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)	0.087	654	1.54	88
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimaric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)	0.19	34	1.54	6.5
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)	0.18	940	1.54	260
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)	0.11	52	1.54	8.8
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.028	240	1.54	10
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)	0.20	82	1.54	25
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)	0.14	107	1.54	23
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.18	139	1	25
d_8-Naphthalene	12.1	136 (100)	137 (11)	0.72	32	1	23
d_{35}-Stearic acid	29.7	77 (100)	91 (60)	0.04	185	1	7.4
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)	0.069	160	1.54	17

*Possibly another trichlorophenol isomer.

Phenols as methyl ethers; fatty acids as methyl esters.

Sample Number: 5121
FRN: 25373[26]

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY

Date Analyzed: 4/1/80 Analyst: KB/CPM

20 µg spike
0.64 ℓ sample

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	Ax / Ais	Cis / RF	Conc. Factor	Conc. (µg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)	0.0070	247	1.56	2.7
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.017	297	1.56	7.8
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)		172		
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	0.136	292	1.56	63
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.072	192	1.56	22
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.14	43	1.56	9.4
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)	0.054	654	1.56	55
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimeric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)	0.20	34	1.56	11
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)	0.29	940	1.56	420
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)	0.14	52	1.56	11
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.020	240	1.56	7.5
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)	0.22	82	1.56	28
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)	0.17	107	1.56	28
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.039	139	1	54
d_8-Naphthalene	12.1	136 (100)	137 (11)	0.20	32	1	6.4
d_{35}-Stearic acid	29.7	77 (100)	91 (60)	0.020	185	1	3.7
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)	0.057	160	1.56	14

Phenols as methyl ethers; fatty acids as methyl esters.

Sample Number: 5122
FRN: 25374[25]

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY

Date Analyzed: 4/1/80 Analyst: KB/CFM

10 μg spike
0.64 ℓ sample

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	Ax/Ais	Cis/RF	Conc. Factor	Conc. (μg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)		247		
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.011	297	1.56	5.2
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)		172		
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	0.068	292	1.56	31
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.071	192	1.56	22
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.12	43	1.56	8.1
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)	0.12	654	1.56	120
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimaric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)	0.15	34	1.56	8.0
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)		940		
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)	0.17	52	1.56	14
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.042	240	1.56	16
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)	0.31	82	1.56	39
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)	0.39	107	1.56	66
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.039	139	1	5.4
d$_8$-Naphthalene	12.1	136 (100)	137 (11)	0.19	32	1	6.1
d$_{35}$-Stearic acid	29.7	77 (100)	91 (60)	0.019	185	1	3.5
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)	0.21	160	1.56	53

Phenols as methyl ethers; fatty acids as methyl esters.

Sample Number: 5123
FRN: 25375[25]

PRIORITY POLLUTANT ANALYTICAL REPORT EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY

Date Analyzed: 4/1/80 Analyst: LG/CFM

20 µg spike
0.60 ℓ sample

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	Ax/Ais	Cis/RF	Conc. Factor	Conc. (µg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)	0.0086	247	1.67	3.5
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.017	297	1.67	8.3
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)	0.014	172	1.67	3.8*
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	0.016	292	1.67	8
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.36	192	1.67	120
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.029	43	1.67	2.0
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)		654		
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimaric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandaracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)		34		
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanoic acid (C21:0)	36.0	74 (100)	87 (30)		940		
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)		52		
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.025	240	1.67	10
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)	0.016	82	1.67	2.2
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)	0.02	107	1.67	3.5
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.074	139	1	10
d_8-Naphthalene	17.1	136 (100)	137 (11)	0.42	32	1	33
d_{35}-Stearic acid	29.7	77 (100)	91 (60)	0.077	185	1	14
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)	0.018	160	1.67	4.8

*Possibly another trichlorophenol isomer.
Phenols as methyl ethers; fatty acids as methyl esters.

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Sample Number: 5124
FRN: 25376[34]

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY
Date Analyzed: 4/1/80 Analyst: LC/CFM

10 µg spike
0.60 l sample

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	Ac/Ais	Cis/RF	Conc. Factor	Conc. (µg/l)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		56		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)		247		
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.004	297	1.67	2.0
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)		172		
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		50		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	0.091	292	1.67	45
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.043	192	1.67	16
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	26.1	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.080	43	1.67	6.5
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)	0.044	616	1.67	48
Fluoranthene	28.8	202 (100)	101 (23), 100 (16)		67		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		402		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimaric acid	30.7	121 (100)	180 (20), 316 (15)		166		
Sandaracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (60), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (31), 314 (20)		36		
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanoic acid (C21:0)	36.0	74 (100)	87 (30)		940		
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.6	273 (100)	275 (33), 274 (20)		32		
bis(2-Ethylhexyl) phthalate	38.2	149 (100)	279 (10)	0.26	240	1.67	100
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)		82		
Dichlorodehydroabietic acid	40.1	307 (100)	309 (67), 311 (20)		107		
Dioctylphthalate	40.8	149 (100)	279 (10)		227		
Neoabietic acid	36.8	135 (100)	316 (70), 301 (37)		166		
Pentafluorophenol	5.0	198 (85)	155 (100), 183 (60)	0.029	130	1	4.0
d_8-Naphthalene	12.1	136 (100)	137 (11)	0.16	32	1	5.1
d_{35}-Stearic acid	28.7	77 (100)	91 (60)	0.060	105	1	9.1
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 296 (5)		160		

Phenols as methyl ethers; fatty acids as methyl esters.

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY

50 μg spike
0.92 ℓ sample

Sample Number: 5125
FRN: 25379[35]
Date Analyzed: 4/2/80
Analyst: KB/CFM

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	Ax/Ais	Cis/RF	Conc. Factor	Conc. (μg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)	0.19	247	1.09	51
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.34	297	1.09	110
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)	0.093	172	1.09	17*
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	1.08	292	1.09	340
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.55	192	1.09	110
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.065	43	1.09	3.0
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)	0.046	654	1.09	33
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimeric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)	0.22	34	1.09	8.2
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)		940		
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)	0.094	52	1.09	5.3
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.42	240	1.09	110
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)	0.15	82	1.09	13
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)	0.10	107	1.09	12
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.16	139	1	22
d_8-Naphthalene	12.1	136 (100)	137 (11)	1.06	32	1	34
d_{35}-Stearic acid	29.7	77 (100)	91 (60)	0.021	185	1	3.9
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)	0.068	160	1.09	12

*Possibly another trichlorophenol isomer.
Phenols as methyl ethers; fatty acids as methyl esters.

Sample Number: 5126
FRN: 25380[036]

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY
Date Analyzed: 4/2/80 Analyst: KB/CFM

20 μg spike
0.88 ℓ sample

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	$\frac{Ax}{Ais}$	$\frac{Cis}{RF}$	Conc. Factor	Conc. (μg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)	0.013	247	1.14	3.6
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.016	297	1.14	5.4
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)	0.011	172	1.14	2.2*
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	0.072	292	1.14	24
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.031	192	1.14	6.8
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.041	43	1.14	2.1
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)	0.032	654	1.14	24
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimeric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)	0.11	34	1.14	4.2
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)		940		
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)	0.072	52	1.14	4.2
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.045	240	1.14	13
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)	0.13	82	1.14	13
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)	0.089	107	1.14	11
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.047	139	1	6.5
d_8-Naphthalene	12.1	136 (100)	137 (11)	0.30	32	1	9.6
d_{35}-Stearic acid	29.7	77 (100)	91 (60)	0.010	185	1	1.9
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)	0.039	160	1.14	7.1

*Possibly another trichlorophenol isomer.
Phenols as methyl ethers; fatty acids as methyl esters.

Sample Number: 5127
FRN: 25381[37]

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY
Date Analyzed: 4/2/80 Analyst: KB/CFM

10 µg spike
0.92 ℓ sample

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	Ax/Ais	Cis/RF	Conc. Factor	Conc. (µg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)		247		
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.0037	297	1.09	1.2
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)		172		
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	0.035	292	1.09	11
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.057	192	1.09	12
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.031	43	1.09	1.4
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)	0.036	654	1.09	26
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimeric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)	0.029	34	1.09	1.1
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)		940		
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)	0.040	52	1.09	2.3
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.022	240	1.09	5.8
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)	0.070	82	1.09	8.0
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)	0.070	107	1.09	8.2
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.028	139	1	3.9
d_8-Naphthalene	12.1	136 (100)	137 (11)	0.18	32	1	5.8
d_{35}-Stearic acid	29.7	77 (100)	91 (60)		185		
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)	0.048	160	1.09	8.4

Phenols as methyl ethers; fatty acids as methyl esters.

Sample Number: 5128
FRN: 25382[38]

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY
Date Analyzed: 4/2/80 Analyst: KB/CFM

200 µg spike
1.0 ℓ sample

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	$\frac{Ax}{Ais}$	$\frac{Cis}{RF}$	Conc. Factor	Conc. (µg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)	0.16	247	X10	400
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.10	297	X10	300
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)	0.19	172	X10	62*
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	3.67	292	X10	11000
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	1.87	192	X10	3600
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.047	43	X10	20
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)	0.19	654	X10	1200
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimeric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)	0.14	34	X10	48
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)		940		
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)	0.051	52	X10	27
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.06	240	X10	2500
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)	0.084	82	X10	69
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)	0.085	107	X10	91
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.064	139	X10	89
d_8-Naphthalene	12.1	136 (100)	137 (11)	0.36	32	X10	120
d_{35}-Stearic acid	29.7	77 (100)	91 (60)	0.022	185	X10	41
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)	0.067	160	X10	110

*Possibly another trichlorophenol isomer.

Phenols as methyl ethers; fatty acids as methyl esters.

50 µg spike
0.92 ℓ sample

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY

Sample Number: 5129
FRN: 25383[39]
Date Analyzed: 4/2/80 Analyst: KB/CFM

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	Ax / Ais	Cis / RF	Conc. Factor	Conc. (µg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)	0.14	247	1.09	38
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.25	297	1.09	80
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)	0.054	172	1.09	10*
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	0.42	292	1.09	130
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.50	192	1.09	100
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.026	43	1.09	1.2
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)	0.024	654	1.09	17
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimeric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)	0.29	34	1.09	11
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)		940		
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)	0.071	52	1.09	4.0
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.35	240	1.09	91
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)	0.20	82	1.09	17
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)	0.10	107	1.09	12
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.10	139	1	14
d_8-Naphthalene	12.1	136 (100)	137 (11)	0.66	32	1	21
d_{35}-Stearic acid	29.7	77 (100)	91 (60)	0.017	185	1	3.1
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)	0.033	160	1.09	5.8

*Possibly another trichlorophenol isomer.

Phenols as methyl ethers; fatty acids as methyl esters.

Sample Number: 5130
FRN: 25384

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY

Date Analyzed: 4/8/80 Analyst: PHL

20 μg spike
0.90 ℓ sample

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	$\frac{Ax}{Ais}$	$\frac{Cis}{RF}$	Conc. Factor	Conc. (μg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)	0.0072	247	1.11	2.0
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.029	297	1.11	10
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)		172		
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	0.12	292	1.11	39
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.11	192	1.11	23
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.066	43	1.11	3.1
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)	0.039	654	1.11	29
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimeric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)	0.27	34	1.11	10
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)	0.11	940	1.11	110
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)	0.16	52	1.11	9.2
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.71	240	1.11	190
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)	0.24	82	1.11	22
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)	0.15	107	1.11	18
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.042	139	1	5.8
d_8-Naphthalene	12.1	136 (100)	137 (11)	0.27	32	1	8.6
d_{35}-Stearic acid	29.7	77 (100)	91 (60)	0.013	185	1	2.4
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)	0.38	160	1.11	6.8

Phenols as methyl ethers; fatty acids as methyl esters.

Sample Number: 5131
FRN: 25385

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY
Date Analyzed: 4/2/80 Analyst: LG/CFM

10 μg spike
0.90 ℓ sample

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	$\frac{Ax}{Ais}$	$\frac{Cis}{RF}$	Conc. Factor	Conc. (μg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)		247		
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.029	297	1.11	10
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)		172		
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	0.086	292	1.11	28
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.083	192	1.11	18
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.053	43	1.11	2.6
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)	0.066	654	1.11	48
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimeric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)	0.15	34	1.11	5.7
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)		940		
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)	0.19	52	1.11	11
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.049	240	1.11	13
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)	0.26	82	1.11	23
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)	0.25	107	1.11	30
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.022	139	1	3.1
d$_8$-Naphthalene	12.1	136 (100)	137 (11)	0.15	32	1	4.8
d$_{35}$-Stearic acid	29.7	77 (100)	91 (60)	0.0086	185	1	1.6
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)	0.10	160	1.11	18

Phenols as methyl ethers; fatty acids as methyl esters.

Sample Number: 5132
FRN: 25386[54]

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY
Date Analyzed: 4/13/80 Analyst: PHL

20 μg spike
0.93 ℓ sample

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	Ax/Ais	Cis/RF	Conc. Factor	Conc. (μg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)	0.0076	247	1.08	2.0
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.070	297	1.08	23
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)	0.017	172	1.08	3.1*
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)	0.033	58	1.08	2.0
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	0.25	292	1.08	79
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.40	192	1.08	83
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.049	43	1.08	2.3
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)	0.085	654	1.08	60
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimeric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)		34		
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)		940		
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)	0.019	52	1.08	1.1
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.29	240	1.08	75
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)	0.041	82	1.08	3.7
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)	0.032	107	1.08	3.7
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.051	139	1	7.1
d_8-Naphthalene	12.1	136 (100)	137 (11)	0.39	32	1	12
d_{35}-Stearic acid	29.7	77 (100)	91 (60)	0.065	185	1.08	12
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)		160		

*Possibly another trichlorophenol isomer.
Phenols as methyl ethers; fatty acids as methyl esters.

Sample Number: 5133
FRN: 25387[57]

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY
Date Analyzed: 4/12/80 Analyst: PHL

10 μg spike
0.90 ℓ sample

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	$\frac{Ax}{Ais}$	$\frac{Cis}{RF}$	Conc. Factor	Conc. (μg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)	0.037	247	1.11	1.0
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.012	297	1.11	4.0
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)		172		
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	0.13	292	1.11	42
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.079	192	1.11	17
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.042	43	1.11	2.0
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)		654		
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimeric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)		34		
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)		940		
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)		52		
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.28	240	1.11	74
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)	0.023	82	1.11	2.1
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)	0.017	107	1.11	2.0
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.019	139	1	2.6
d_8-Naphthalene	12.1	136 (100)	137 (11)	0.15	32	1	4.8
d_{35}-Stearic acid	29.7	77 (100)	91 (60)	0.041	185	1	7.6
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)	0.021	160	1.11	3.8

Phenols as methyl ethers; fatty acids as methyl esters.

Sample Number: 5171
FRN: 25302[197]

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY

Date Analyzed: 3/24/80 Analyst: LG/CFM

20 μg spike
0.92 ℓ sample

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	Ax/Ais	Cis/RF	Conc. Factor	Conc. (μg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)		247		
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)		297		
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)		172		
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	0.19	292	1.09	63
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.11	192	1.09	23
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.074	43	1.09	3.5
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)	0.038	654	1.09	28
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimeric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)	0.33	34	1.09	12
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)		940		
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)	0.16	52	1.09	9.0
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.40	240	1.09	100
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)	0.24	82	1.09	22
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)	0.21	107	1.09	22
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.065	139	1	9.0
d_8-Naphthalene	12.1	136 (100)	137 (11)	0.28	32	1	9.0
d_{35}-Stearic acid	29.7	77 (100)	91 (60)	0.011	185	1.09	2.0
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)		160		

Phenols as methyl ethers; fatty acids as methyl esters.

Sample Number: 5172
FRN: 25301

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY
Date Analyzed: 4/2/80 Analyst: PHL

10 µg spike
0.96 ℓ sample

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	Ax/Ais	Cis/RF	Conc. Factor	Conc. (µg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)		247		
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.062	297	1.04	19
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)		172		
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	0.11	292	1.04	33
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.072	192	1.04	15
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.056	43	1.04	2.5
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)	0.098	654	1.04	67
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimeric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)	0.20	34	1.04	7.1
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)	0.15	940	1.04	150
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)	0.32	52	1.04	18
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.48	240	1.04	120
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)	0.48	82	1.04	41
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)	0.70	107	1.04	78
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.045	139	1	6.3
d_8-Naphthalene	12.1	136 (100)	137 (11)	0.13	32	1	4.2
d_{35}-Stearic acid	29.7	77 (100)	91 (60)		185		
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)	0.12	160	1.04	20

Phenols as methyl ethers; fatty acids as methyl esters.

203

Sample Number: 5173
FRN: 25293

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY
Date Analyzed: 4/2/80 Analyst: PHL

50 μg spike
0.92 ℓ sample

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	Ax / Ais	Cis / RF	Conc. Factor	Conc. (μg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)	0.14	247	1.09	38
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.17	297	1.09	54
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)		172		
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	0.71	292	1.09	220
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.43	192	1.09	90
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.051	43	1.09	2.4
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)	0.048	654	1.09	34
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimeric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)	0.39	34	1.09	14
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)	0.45	940	1.09	460
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)	0.14	52	1.09	7.9
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)		240		
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)	0.21	82	1.09	19
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)	0.16	107	1.09	19
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.13	139	1	18
d_8-Naphthalene	12.1	136 (100)	137 (11)	0.63	32	1	20
d_{35}-Stearic acid	29.7	77 (100)	91 (60)		185		
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)		160		

Phenols as methyl ethers; fatty acids as methyl esters.

Sample Number: 5174 Rerun
FRN: 25404[59]

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY
Date Analyzed: 4/7/80 Analyst: KB/CFM

50 µg spike
0.95 ℓ sample

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	Ax/Ais	Cis/RF	Conc. Factor	Conc. (µg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)	0.066	247	1.05	17
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.14	297	1.05	44
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)	0.045	172	1.05	8.1*
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	0.49	292	1.05	150
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.34	192	1.05	68
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.031	43	1.05	1.4
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)	0.031	654	1.05	21
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimaric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)	0.50	34	1.05	18
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)		940		
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)	0.21	52	1.05	12
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.34	240	1.05	86
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)	0.30	82	1.05	28
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)	0.19	107	1.05	21.1
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.10	139	1	14
d_8-Naphthalene	12.1	136 (100)	137 (11)	0.86	32	1	28
d_{35}-Stearic acid	29.7	77 (100)	91 (60)	0.025	185	1	4.6
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)	0.043	160	1.05	7.3

*Possibly another trichlorophenol isomer.
Phenols as methyl ethers; fatty acids as methyl esters.

Sample Number: 5175
FRN: 25295

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY
Date Analyzed: 4/6/80 Analyst: PHL

20 µg spike
0.95 l sample

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	As/Ais	Cis/RF	Conc. Factor	Conc. (µg/l)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.7	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)	0.0083	247	1.05	2.2
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.16	297	1.05	51
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)		172		
Diethylphthalate	20.6	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	0.22	292	1.05	67
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.16	192	1.05	33
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.73	43	1.05	3.3
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)	0.046	654	1.05	32
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		67		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimaric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandaracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)	0.37	36	1.05	14
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanoic acid (C21:0)	36.0	74 (100)	87 (30)	0.18	940	1.05	180
Chrysene	36.0	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.6	273 (100)	275 (33), 274 (20)	0.23	52	1.05	13
bis(2-ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.60	240	1.05	130
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)	0.21	82	1.05	20
Dichlorodehydroabietic acid	40.1	307 (100)	309 (67), 311 (20)	0.28	107	1.05	32
Dioctylphthalate	40.8	149 (100)	279 (10)		227		
Neoabietic acid	36.8	135 (100)	316 (70), 121 (37)		166		
Pentafluorophenol	5.8	198 (80)	183 (100), 155 (60)	0.11	130	1	15
d_8-Naphthalene	12.1	136 (100)	137 (11)	0.52	32	1	17
d_{35}-Stearic acid	26.7	77 (100)	90 (60)		105		
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)	0.0095	160	1.05	16

Phenols as methyl ethers; fatty acids as methyl esters.

Sample Number: 5176
FRN: 25303

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY

Date Analyzed: 3/24/80 Analyst: LG/CFM

20 µg spike
0.93 ℓ sample

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	Ax/Ais	Cis/RF	Conc. Factor	Conc. (µg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)		247		
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.049	297	1.08	16
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)		172		
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	0.11	292	1.08	34
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.10	192	1.08	20
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.034	43	1.08	1.6
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)		654		
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimeric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)		34		
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)	0.019	940	1.08	19
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)	0.020	52	1.08	1.1
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.19	240	1.08	50
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)	0.029	82	1.08	2.6
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)	0.020	107	1.08	2.3
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.095	139	1	13
d_8-Naphthalene	12.1	136 (100)	137 (11)	0.33	32	1	10
d_{35}-Stearic acid	29.7	77 (100)	91 (60)	0.052	185	1	9.6
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)		160		

Phenols as methyl ethers; fatty acids as methyl esters.

Sample Number: 5177
FRN: 25304[197]

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY

Date Analyzed: 4/2/80 Analyst: PHL

10 μg spike
0.80 ℓ sample

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	$\frac{Ax}{Ais}$	$\frac{Cis}{RF}$	Conc. Factor	Conc. (μg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)	0.12	247	1.25	3.8
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.15	297	1.25	5.7
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)		172		
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)	0.046	58	1.25	3.4
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	0.14	292	1.25	51
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.075	192	1.25	18
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.12	43	1.25	6.5
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)		654		
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimeric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)		34		
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)		940		
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)		52		
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.77	240	1.25	220
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)		82		
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)		107		
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.039	139	1	5.4
d_8-Naphthalene	12.1	136 (100)	137 (11)	0.17	32	1	5.4
d_{35}-Stearic acid	29.7	77 (100)	91 (60)	0.039	185	1	7.2
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)		160		

Phenols as methyl ethers; fatty acids as methyl esters.

Sample Number: 5178
FRN: 25378

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY

Date Analyzed: 4/7/80 Analyst: PHL

50 μg spike
0.95 ℓ sample

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	Ax / Ais	Cis / RF	Conc. Factor	Conc. (μg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)	0.21	247	1.05	55
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.31	297	1.05	47
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)	0.077	172	1.05	14*
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	0.65	292	1.05	200
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.55	192	1.05	120
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)		43		
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)	0.027	654	1.05	19
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimeric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)	0.32	34	1.05	12
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)		940		
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)	0.094	52	1.05	5.2
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.096	240	1.05	24
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)	0.17	82	1.05	15
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)	0.1	107	1.05	12
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.14	139	1	19
d_8-Naphthalene	12.1	136 (100)	137 (11)	0.92	32	1	29
d_{35}-Stearic acid	29.7	77 (100)	91 (60)	0.0087	185	1	1.6
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)		160		

*Possibly another trichlorophenol isomer.
Phenols as methyl ethers; fatty acids as methyl esters.

20 μg spike
0.63 ℓ sample

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY

Sample Number: 5179
FRN: 25306[189]　Date Analyzed: 3/24/80　Analyst: LG/CFM

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	Ax/Ais	Cis/RF	Conc. Factor	Conc. (μg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)	0.0062	247	1.59	2.4
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.0092	297	1.59	4.3
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)	0.015	172	1.59	4.1*
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	0.20	292	1.59	92
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.29	192	1.59	89
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.052	43	1.59	3.5
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)	0.011	654	1.59	12
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimeric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)		34		
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)		940		
Chrvsene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)		52		
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.51	240	1.59	190
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)	0.021	82	1.59	2.7
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)	0.018	107	1.59	3.0
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.092	139	1	13
d_8-Naphthalene	12.1	136 (100)	137 (11)	0.36	32	1	12
d_{35}-Stearic acid	29.7	77 (100)	91 (60)	0.056	185	1	10
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)	0.014	160	1.59	3.5

*Possibly another trichlorophenol isomer.
Phenols as methyl ethers; fatty acids as methyl esters.

Sample Number: 5180
FRN: 25307[198]

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY
Date Analyzed: 4/9/80 Analyst: KJB

50 µg spike
1.0 ℓ sample

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	Ax/Ais	Cis/RF	Conc. Factor	Conc. (µg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)	0.21	247	1	52
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.41	297	1	120
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)	0.16	172	1	28*
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	1.07	292	1	310
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.57	192	1	109
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.06	43	1	26
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)	0.025	654	1	16
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimeric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)	0.40	34	1	14
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)	0.05	940	1	47
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)	0.16	52	1	8.3
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.07	240	1	17
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)	0.22	82	1	18
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)	0.13	107	1	14
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.21	139	1	29
d_8-Naphthalene	12.1	136 (100)	137 (11)	0.79	32	1	25
d_{35}-Stearic acid	29.7	77 (100)	91 (60)	0.012	185	1	2.2
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)		160		

*Possibly another trichlorophenol isomer.
Phenols as methyl ethers; fatty acids as methyl esters.

20 μg spike
0.98 ℓ sample

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY

Sample Number: 5181
FRN: 25315

Date Analyzed: 4/7/80 Analyst: PHL

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	$\frac{Ax}{Ais}$	$\frac{Cis}{RF}$	Conc. Factor	Conc. (μg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)		247		
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.067	297	1.02	20
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)		172		
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	0.24	292	1.02	71
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.14	192	1.02	28
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.052	43	1.02	2.3
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)		654		
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimeric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)	0.46	34	1.02	16
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)	0.015	940	1.02	14
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)	0.17	52	1.02	9.0
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.31	240	1.02	76
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)	0.25	82	1.02	21
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)	0.17	107	1.02	18
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.040	139	1	5.6
d_8-Naphthalene	12.1	136 (100)	137 (11)	0.19	32	1	6.1
d_{35}-Stearic acid	29.7	77 (100)	91 (60)	0.013	185	1	2.4
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)	0.028	160	1.02	4.6

Phenols as methyl ethers; fatty acids as methyl esters.

Sample Number: 5182
FRN: 25402[42]

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY
Date Analyzed: 4/4/80 Analyst: LG/CFM

10 µg spike
0.90 ℓ sample

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	Ax/Ais	Cis/RF	Conc. Factor	Conc. (µg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)		247		
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.041	297	1.11	13
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)		172		
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	0.13	292	1.11	42
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.081	192	1.11	18
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.049	43	1.11	2.3
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)	0.068	654	1.11	49
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimeric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)	0.19	34	1.11	7.2
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)		940		
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)	0.20	52	1.11	11
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.32	240	1.11	86
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)	0.29	82	1.11	27
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)	0.24	107	1.11	29
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.027	139	1	3.8
d_8-Naphthalene	12.1	136 (100)	137 (11)	0.21	32	1	6.7
d_{35}-Stearic acid	29.7	77 (100)	91 (60)	0.021	185	1	3.9
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)	0.12	160	1.11	21

Phenols as methyl ethers; fatty acids as methyl esters.

50 µg spike
1.0 ℓ sample

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY

Sample Number: 5183
FRN: 25318
Date Analyzed: 4/6/80 Analyst: PHL

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	Ax/Ais	Cis/RF	Conc. Factor	Conc. (µg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)	0.11	247	1	27
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.13	297	1	39
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)		172		
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	0.82	292	1	240
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.44	192	1	84
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.03	43	1	1.3
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)	0.015	654	1	9.8
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimeric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)	0.097	34	1	3.3
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)	0.033	940	1	31
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)	0.23	52	1	12
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.34	240	1	82
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)	0.32	82	1	26
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)	0.10	107	1	11
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.16	139	1	22
d_8-Naphthalene	12.1	136 (100)	137 (11)	0.59	32	1	19
d_{35}-Stearic acid	29.7	77 (100)	91 (60)		185		
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)	0.038	160	1	6.1

Phenols as methyl ethers; fatty acids as methyl esters.

Sample Number: 5184
FRN: 52319[191]

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY
Date Analyzed: 3/25/80 Analyst: LG/CFM

20 µg spike
0.94 ℓ sample

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	Ax/Ais	Cis/RF	Conc. Factor	Conc. (µg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)		247		
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.0086	297	2.7	6.9
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)		172		
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	0.059	292	2.7	47
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.039	192	2.7	20
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.016	43	2.7	1.9
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)	0.0086	654	2.7	15
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimeric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)	0.054	34	2.7	5.0
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)		940		
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)	0.032	52	2.7	4.5
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.053	240	2.7	34
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)	0.049	82	2.7	11
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)	0.056	107	2.7	16
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.022	139	2.5	7.6
d_8-Naphthalene	12.1	136 (100)	137 (11)	0.074	32	2.5	5.9
d_{35}-Stearic acid	29.7	77 (100)	91 (60)		185		
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)		160		

Phenols as methyl ethers; fatty acids as methyl esters.

10 µg spike
0.94 ℓ sample

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY

Sample Number: 5185
FRN: 25437[74]
Date Analyzed: 4/15/80 Analyst: LG/CFM

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	Ax/Ais	Cis/RF	Conc. Factor	Conc. (µg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)		247		
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.016	297	1.06	5.1
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)		172		
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	0.077	292	1.06	23
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.036	192	1.06	7.3
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.035	43	1.06	1.6
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)	0.04	654	1.06	28
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimeric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)		34		
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)		940		
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)	0.069	52	1.06	3.8
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.85	240	1.06	210
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)	0.10	82	1.06	8.7
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)	0.12	107	1.06	14
Dioctylphthalate	46.8	149 (100)	279 (10)	0.20	227	1.06	48
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.025	139	1	3.5
d_8-Naphthalene	12.1	136 (100)	137 (11)	0.10	32	1	3.2
d_{35}-Stearic acid	29.7	77 (100)	91 (60)		185		
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)	0.038	160	1.06	6.9

Phenols as methyl ethers; fatty acids as methyl esters.

Sample Number: 5186
FRN: 25438[77]

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY
Date Analyzed: 4/15/80 Analyst: LG/CPM

20 μg spike
0.74 ℓ sample

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	Ax/Ais	Cis/RF	Conc. Factor	Conc. (μg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)		247		
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.014	297	1.35	5.7
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)		172		
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	0.10	292	1.35	39
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.043	192	1.35	11
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.024	43	1.35	1.4
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)	0.071	654	1.35	62
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimeric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)	0.048	34	1.35	2.2
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)		940		
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)	0.085	52	1.35	6.0
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.58	240	1.35	190
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)	0.12	82	1.35	13
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)	0.17	107	1.35	24
Dioctylphthalate	46.8	149 (100)	279 (10)	0.12	227	1.35	37
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.81	139	1	11
d_8-Naphthalene	12.1	136 (100)	137 (11)	0.25	32	1	8.0
d_{35}-Stearic acid	29.7	77 (100)	91 (60)		185		
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)	0.18	160	1.35	39

Phenols as methyl ethers; fatty acids as methyl esters.

10 µg spike
0.78 ℓ sample

Sample Number: 5187
FRN: 25330[199]

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY

Date Analyzed: 3/27/80 Analyst: PHL/CFM

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	Ax/Ais	Cis/RF	Conc. Factor	Conc. (µg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)		247		
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)		297		
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)		172		
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	0.051	292	1.28	19
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.025	192	1.28	6.2
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.081	43	1.28	4.4
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)	0.021	654	1.28	18
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimeric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)	0.059	34	1.28	2.6
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)		940		
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)	0.084	52	1.28	5.6
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.25	240	1.28	77
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)	0.14	82	1.28	11
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)	0.26	107	1.28	36
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.015	139	1	2.1
d_8-Naphthalene	12.1	136 (100)	137 (11)	0.085	32	1	2.7
d_{35}-Stearic acid	29.7	77 (100)	91 (60)	0.019	185	1	3.5
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)	0.14	160	1.28	28

Phenols as methyl ethers; fatty acids as methyl esters.

Sample Number: 5188
FRN: 25326[15]

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY
Date Analyzed: 3/26/80 Analyst: LG/CFM

20 µg spike
0.95 ℓ sample

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	Ax / Ais	Cis / RF	Conc. Factor	Conc. (µg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)		247		
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.027	297	1.05	8.4
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)		172		
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	0.16	292	1.05	49
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.12	192	1.05	24
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.079	43	1.05	3.4
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)	0.018	654	1.05	12
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimaric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandaracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)	0.084	34	1.05	3.0
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		280		
Heneicosanoic acid (C21:0)	36.0	74 (100)	87 (30)		940		
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)	0.047	52	1.05	2.6
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.048	240	1.05	12
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)	0.073	82	1.05	6.3
Dichlorodehydroabietic acid	40.1	307 (100)	309 (65), 311 (20)	0.048	107	1.05	5.4
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.022	139	1	3.0
d_8-Naphthalene	12.1	136 (100)	137 (11)	0.215	32	1	6.9
d_{35}-Stearic acid	29.7	77 (100)	91 (60)	0.0079	105	1	1.5
9,10-Dichlorostearic acid	37.5	76 (100)	87 (60), 294 (3)	0.032	160	1.05	5.4

Phenols as methyl ethers; fatty acids as methyl esters.

Sample Number: 5100
PMN: 21389[36]

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY

Date Analyzed: 6/3/80 Analyst: KB/CPM

10 µg spike
0.96 l sample

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	Ax/Ais	Cis/RF	Conc. Factor	Conc. (µg/l)
Phenol	5.8	94 (100)	65(91), 39(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		56		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		60		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)	0.0054	267	1.06	1.4
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.022	257	1.06	6.0
2,4,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)		172		
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	0.20	292	1.06	60
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		96		
Tetrachloroguaiacol	22.8	276 (95)	263 (100), 278 (95)	0.93	182	1.06	17**
Pentachlorophenol	23.8	266 (95)	263 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.1	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 206 (10)	0.036	63	1.06	1.6
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)	0.067	616	1.06	32
Fluoranthene	28.8	202 (100)	101 (25), 100 (14)		67		
Linoleic acid (C18:2)	29.3	67	294 (5)		521		
Linolenic acid (C18:3)	29.3	79	292 (5)		682		
Oleic acid (C18:1)	29.4	55	296 (5)		663		
Pyrene	29.6	202 (100)	200 (20)		60		
Pimaric acid	31.7	121 (100)	180 (25), 316 (17)		156		
Sandaracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		91		
Isopimaric acid	32.8	241 (100)	256 (60), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (7), 314 (20)	0.062	36	1.06	2.2
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Eicosanoic acid (C20:0)	36.0	74 (100)	87 (85)		960		
Chrysene	36.8	228 (100)	229 (19), 226 (23)		110		
Chlorodehydroabietic acid (a)	38.6	273 (100)	275 (35), 274 (20)	0.017	92	1.06	3.1
bis(2-Ethylhexyl) phthalate	38.3	149 (100)	279 (10)	0.037	260	1.06	9.3
Chlorodehydroabietic acid (b)	38.5	273 (100)	275 (35), 274 (20)	0.062	82	1.06	5.5
Dichlorodehydroabietic acid	40.5	307 (100)	309 (67), 311 (20)	0.038	127	1.06	5.8
Dioctylphthalate	40.8	149 (100)	279 (10)		227		
Neoabietic acid	36.8	135 (100)	316 (78), 301 (37)		300		
Pentafluorophenol	5.0	184 (80)	155 (100), 185 (60)	0.055	139	1	7.7
d_8-Naphthalene	12.1	136 (100)	137 (11)	0.30	92	1	33
d_{35}-Stearic acid	29.7	77 (100)	93 (60)		105		
2,20-Dibromoeicosanoic acid	35.5	76 (100)	87 (60), 286 (5)		100		

*Possibly another trichlorophenol isomer.
**Results as methyl ether; [illegible] in methyl column.

Sample Number: 5190
FRN: 25390[56]

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY
Date Analyzed: 4/3/80 Analyst: LG

10 μg spike
0.89 ℓ sample

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	Ax/Ais	Cis/RF	Conc. Factor	Conc. (μg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)	0.014	247	1.12	3.9
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)	0.030	297	1.12	10
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)		172		
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)	0.13	292	1.12	43
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)	0.12	192	1.12	26
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.022	43	1.12	1.1
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)		654		
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimeric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)		34		
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)		940		
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)		52		
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.21	240	1.12	56
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)		82		
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)		107		
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.026	139	1	3.6
d_8-Naphthalene	12.1	136 (100)	137 (11)	0.18	32	1	5.8
d_{35}-Stearic acid	29.7	77 (100)	91 (60)	0.023	185	1	4.4
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)		160		

Phenols as methyl ethers; fatty acids as methyl esters.

Sample Number: 5191
FRN: 25397

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY
Date Analyzed: 4/4/80 Analyst: KB/CFM

0 µg spike
1.0 ℓ sample

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	Ax / Ais	Cis / RF	Conc. Factor	Conc. (µg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)		247		
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)		297		
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)		172		
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)		292		
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)		192		
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.033	43	1	1.4
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)		654		
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimeric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)		34		
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)		940		
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)		52		
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.20	240	1	48
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)		82		
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)		107		
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)		139		
d_8-Naphthalene	12.1	136 (100)	137 (11)		32		
d_{35}-Stearic acid	29.7	77 (100)	91 (60)		185		
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)		160		

Phenols as methyl ethers; fatty acids as methyl esters.

Sample Number: 5192
FRN: 25411[67]

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY
Date Analyzed: 4/8/80 Analyst: KB/CFM

20 µg spike
1.0 ℓ sample

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	Ax / Ais	Cis / RF	Conc. Factor	Conc. (µg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)		68		
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)		247		
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)		297		
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)		172		
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)		292		
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)		192		
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.026	43	1	1.1
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)		654		
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimeric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)		34		
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)		940		
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)		52		
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.013	240	1	3.1
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)		82		
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)		107		
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)	0.10	139	1	14
d_8-Naphthalene	12.1	136 (100)	137 (11)	0.49	32	1	16
d_{35}-Stearic acid	29.7	77 (100)	91 (60)	0.18	185	1	33
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)		160		

Phenols as methyl ethers; fatty acids as methyl esters.

0 µg spike
Solvent Blank

PRIORITY POLLUTANT ANALYTICAL REPORT: EXTRACTABLES
SWEDISH ION EXCHANGE TREATMENT TECHNOLOGY

Sample Number: 5193
FRN: 25399[42]
Date Analyzed: 4/4/80
Analyst: LG/CFM

Compound	Retention Time (Minutes)	Quantitative Ion (Base Peak)	Secondary Ions (Percent)	Ax / Ais	Cis / RF	Conc. Factor	Conc. (µg/ℓ)
Phenol	5.9	108 (100)	65(95), 78(75)		93		
Isophorone	8.3	82 (100)	138(20), 95(10)		54		
Naphthalene	12.2	128 (100)	127(10), 129(11)		81		
Hexachlorobutadiene	13.1	225 (100)	223(63), 227(65)	0.018	68	1	1.2
2,4-Dichlorophenol	13.9	176 (90)	161 (100), 163 (65)		247		
2,4,6-Trichlorophenol	15.1	210 (60)	195 (100), 197 (95)		297		
2,3,5-Trichlorophenol	17.5	210 (100)	195 (20), 197 (20)		172		
Diethylphthalate	20.4	149 (100)	177 (25), 150 (10)		58		
Trichloroguaiacol	21.2	240 (100)	225 (95), 242 (95)		292		
4-Bromophenyl phenyl ether	22.5	248 (90)	117 (100), 250 (90)		94		
Tetrachloroguaiacol	22.8	276 (95)	261 (100), 278 (95)		192		
Pentachlorophenol	23.8	280 (85)	265 (100), 267 (60)		161		
Phenanthrene/Anthracene	24.3	178 (100)	179 (16), 176 (15)		50		
Dibutyl phthalate	27.0	149 (100)	150 (27), 104 (10)	0.079	43	1	3.4
Heptadecanoic acid	28.2	74 (100)	87 (75), 284 (10)		654		
Fluoranthene	28.8	202 (100)	101 (23), 100 (14)		47		
Linoleic acid (C18:2)	29.3	67	294 (3)		525		
Linolenic acid (C18:3)	29.3	79	292 (3)		492		
Oleic acid (C18:1)	29.4	55	296 (3)		663		
Pyrene	29.6	202 (100)	200 (20)		40		
Pimeric acid	31.7	121 (100)	180 (20), 316 (15)		166		
Sandracopimaric acid	32.2	121 (100)	241 (13), 316 (18)		95		
Isopimaric acid	32.9	241 (100)	256 (40), 316 (30)		161		
Dehydroabietic acid	33.6	239 (100)	240 (5), 314 (20)		34		
Abietic acid	34.8	256 (90)	121 (100), 316 (60)		288		
Heneicosanic acid (C21:0)	36.0	74 (100)	87 (30)		940		
Chrysene	36.8	228 (100)	229 (19), 226 (23)		118		
Chlorodehydroabietic acid (A)	38.4	273 (100)	275 (33), 274 (20)		52		
bis(2-Ethylhexyl) phthalate	39.2	149 (100)	279 (10)	0.43	240	1	103
Chlorodehydroabietic acid (B)	39.5	273 (100)	275 (33), 274 (20)		82		
Dichlorodehydroabietic acid	46.1	307 (100)	309 (65), 311 (20)		107		
Dioctylphthalate	46.8	149 (100)	279 (10)		227		
Neoabietic acid	34.8	135 (100)	316 (78), 221 (37)		166		
Pentafluorophenol	5.0	198 (80)	155 (100), 183 (60)		139		
d_8-Naphthalene	12.1	136 (100)	137 (11)		32		
d_{35}-Stearic acid	29.7	77 (100)	91 (60)	0.014	185	1	2.6*
9,10-Dichlorostearic acid	37.5	74 (100)	87 (60), 294 (3)		160		

***Positive interference; no spike added.**
Phenols as methyl ethers; fatty acids as methyl esters.

5.0 TRACE ELEMENT ANALYSIS

All analyses were performed using the graphite furnace atomic absorption technique except zinc which was analyzed by flame AA. The standard parameters for each element are included in Table 5-1. Arsenic and selenium were analyzed with a graphite furnace using nickel nitrate addition. This addition consists of adding 0.1 mℓ of 1% $Ni(NO_3)_2$ to 1.0 mℓ of the samples and standards. This addition allows an increased charring temperature for the analysis therefore eliminating interferences.

Standards were prepared, analyzed, and plotted to produce a standard curve. The samples were then analyzed with the absorbance peaks measured on a strip chart recorder. Peak heights were compared to peak heights of the standards to calculate the concentration of the samples.

Zinc was analyzed using an air/acetylene flame at 214.9 nm. All other elements were analyzed using standard flameless AA techniques utilizing a strip chart recorder and standards to calculate concentration. Analytical data is presented in Table 5-2.

TABLE 5-1. ANALTYICAL PARAMETERS FOR TRACE ELEMENT ANALYSES

Element	Wavelength (nm)	Aliquot	Digestion Type	Dry ($^{\circ}C$)	Char ($^{\circ}C$)	Atomize ($^{\circ}C$)
Sb	217.6	20µℓ	1	100	450	2200
As	193.7	20µℓ	2	100	450	2500
Be	234.9	20µℓ	1	100	1200	2700
Cd	228.8	20µℓ	2	100	450	2200
Cr	357.9	20µℓ	2	100	850	2500
Cu	324.9	20µℓ	2	100	1300	2600
Pb	283.3	20µℓ	2	100	450	2300
Ni	232.0	20µℓ	2	100	1200	2700
Se	196.0	20µℓ	2	100	1000	2500
Ag	328.1	20µℓ	2	100	850	2500
Tl	276.8	20µℓ	2	100	450	2300
Zn	214.9	Flame Type = Air/Acetylene Lean Blue HNO_3/HCl digestion.				

1 = HNO_3/HCl

2 = HNO_3/H_2O_2

TABLE 5-2.
TRACE ELEMENT CONCENTRATIONS IN SWEDISH PULP MILL SAMPLES[1]

Radian Sample Number	Sample Description	Concentrations in μg/ℓ											
		Sb	As	Be	Cd	Cr	Cu	Pb	Ni	Se	Ag	Tl	Zn
4904	SWE-5194 26M1	<3	6	<0.5	1.5	33	19	4	52	5	0.6	<2	150
4905	SWE-5195 26M2	5	14	<0.5	1.5	32	10	2	53	12	1.8	<2	92
4906	SWE-5196 26M3	<3	7	<0.5	1.5	38	31	6	57	6	1.2	<2	200
4907	SWE-5197 26M4	<3	10	<0.5	<0.5	33	8	2	25	8	0.5	<2	85
4908	SWE-5198 26M5	<3	5	<0.5	0.8	28	19	8	86	<4	2.1	<2	59
4909	SWE-5199 26M6	<3	5	<0.5	1.0	23	28	3	52	<4	<0.5	<2	120
4910	SWE-5200 26M7	<3	5	<0.5	1.3	23	16	4	99	<4	0.6	<2	150
4911	SWE-5201 4M1	<3	8	<0.5	620	32	25	3	100	5	1.3	<2	160
4912	SWE-5202 4M2	<3	5	<0.5	670	29	20	2	160	<4	0.9	<2	140
4913	SWE-5203 4M3	<3	3	<0.5	0.6	13	7	<1	17	<4	<0.5	9	110
4914	SWE-5204 4M4	<3	<2	<0.5	2.5	51	44	3	<5	<4	0.6	8	490
4915	SWE-5205 4M5	<3	<2	<0.5	2.8	5	59	4	<5	<4	<0.5	<5	490
4916	SWE-5206 4M6	<3	8	<0.5	1.2	37	38	4	22	<4	0.6	10	160
4917	SWE-5207 4M7	<3	6	<0.5	0.9	32	17	2	39	<4	0.9	14	110
4918	SWE-5208 4M8	4	11	<0.5	0.7	35	29	<1	37	8	0.8	9	79
4919	SWE-5209 5M1	<3	6	<0.5	320	29	49	<1	70	<4	1.6	16	130
5920	SWE-5210 5M2	<3	<2	<0.5	1.2	5	4	<1	<5	<4	<0.5	18	110
4921	SWE-5211 5M3	<3	9	<0.5	270	35	20	<1	120	6	1.1	12	70
4922	SWE-5212 5M4	<3	7	<0.5	190	31	25	2	98	5	0.9	21	140
4923	SWE-5213 5M5	<3	<2	<0.5	140	30	11	<1	86	6	0.8	14	110
4924	SWE-5214 5M6	<3	<2	<0.5	2.0	10	38	2	<5	<4	<0.5	<2	470
4925	SWE-5215 5M7	<3	<2	<0.5	2.6	32	39	3	14	<4	<0.5	<2	520

Continued

TABLE 5-2.

TRACE ELEMENT CONCENTRATIONS IN SWEDISH PULP MILL SAMPLES (Continued)

Radian Sample Number	Sample Description	Concentrations in μg/ℓ											
		Sb	As	Be	Cd	Cr	Cu	Pb	Ni	Se	Ag	Tl	Zn
4926	SWE-5216 5M8	53	140	16	280	1200	56	11	400	56	15	26	390
4927	SWE-5217 5M9	<3	7	<0.5	160	28	33	2	<5	<4	0.7	49	160
4928	SWE-5218 5M10	<3	<2	<0.5	2.9	42	24	4	<5	<4	<0.5	<2	470
4929	SWE-5219 5M11	<3	7	<0.5	230	36	26	2	230	5	0.8	26	160
4930	SWE-5220 5M12	<3	10	<0.5	180	34	12	<1	130	6	1.4	34	120
4931	SWE-5221 5M13	<3	3	<0.5	0.6	22	5	21	110	<4	<0.5	16	110
4932	SWE-5222 5M14	<3	6	<0.5	440	32	38	2	15	6	0.6	38	170
4933	SWE-5223 5M15	<3	6	<0.5	490	29	20	<1	10	6	0.9	33	120
4934	SWE-5224 5M16	<3	<2	<0.5	0.9	17	7	<1	46	<4	<0.5	23	100
4935	SWE-5225 5M17	<3	<2	<0.5	2.3	39	46	5	54	<4	<0.5	<2	470
4936	SWE-5226 5M18	<3	<2	<0.5	2.4	15	41	5	32	<4	<0.5	<2	610
4937	SWE-5227 6M1	<3	5	<0.5	380	31	25	2	19	6	1.0	31	170
4938	SWE-5228 6M2	<3	6	<0.5	5.9	33	30	<1	8	<4	1.0	35	120
4939	SWE-5229 6M3	<3	3	<0.5	0.6	25	5	<1	<5	<4	<0.5	23	110
4940	SWE-5230 6M4	<3	7	<0.5	190	30	9	<1	<5	<4	0.7	20	140
4941	SWE-5231 6M5	<3	<2	<0.5	0.8	22	4	<1	<5	<4	<0.5	14	98
4942	SWE-5232 6M6	<3	6	<0.5	180	28	16	2	<5	<4	1.2	<2	130
4943	SWE-5233 6M7	<3	6	<0.5	0.8	38	21	2	40	<4	0.8	<2	120
4944	SWE-5234 6M8	<3	3	<0.5	3.6	73	26	8	33	<4	<0.5	<2	850

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[1] All concentrations are expressed as ppb (μg/ℓ).

6.0 QUALITY ASSURANCE

A comprehensive quality assurance program was designed to define the validity of the data produced during this study. Parameters covered include instrument performance, recovery data, precision and accuracy. These are covered in the following subsections.

6.1 Mass Spectrometric Quality Control

Specific quality control activities were employed during the analyses for the Priority Pollutants. These encompassed the EPA Priority Pollutant procedures as well as additional measures developed at Radian.

Radian's GC-MS laboratory is physically isolated from other laboratories at Radian. In order to minimize possible contamination from laboratory solvents, only non-Priority Pollutant solvents such as acetone, methanol or hexane are utilized in the laboratory for cleaning syringes and preparing standards. The VOA samples are also stored in a refrigerator located in the GC-MS laboratory. These precautions result in a relatively "clean" laboratory as indicated by the analysis of Radian's blank water. Priority Pollutants are seldom detected above a level of 0.5 ppb in blank water samples.

A GC-MS system performance evaluation is conducted daily to demonstrate the sensitivity of the instrument. The tune of the instrument is checked by examination of the mass spectrum obtained from the injection of 50 ng of decafluorotriphenylphosphine. If the ion intensities for this compound are outside specified criteria, the instrument is returned.

In the analysis of the volatile compounds, the sample matrix can affect the purging efficiencies of individual compounds. Therefore, both samples and sample blanks are spiked with two internal standards in order to measure the relative matrix effect of the samples analyzed. After each analysis, the areas under the selected ion profiles for each of the two internal standards are measured. The ratio of these areas is recorded on a quality control chart. Also, each VOA sample is spiked with three deuterated standards, d_4-dichloroethane, d_6-benzene and d_8-toluene at known levels, to measure overall efficiences for the purge and trap analysis.

Blanks are an important part of the quality assurance and are especially critical with the purge/trap techniques since the purging device and the trap can be contaminated by residues from very concentrated samples or by vapors in the laboratory. Two types of blank samples are analyzed at Radian as part of the VOA analysis. Field blanks are samples of organic-free water which have been transported to the sampling site and are then analyzed as all other samples. Laboratory blanks are prepared at Radian by purging organic-free water. This water is analyzed before and after each sample to demonstrate the cleanliness of the GC-MS system. If positive interferences are noted in these blank analyses, additional procedures are employed until the interferences are no longer present. These procedures include analysis of additional blanks, purging and baking out of the system or a complete cleaning of the part that contact the sample.

Standard mixtures of the Priority Pollutants are analyzed frequently to determine the appropriate response factors for each compound. Radian has all of the Priority Pollutants in a purified form, thus permitting new standards to be prepared as required.

A number of blind quality assurance (QA) samples were submitted to the GC-MS Laboratory during the period that the samples in this report were analyzed. These samples, coordinated by Radian's Quality Assurance Director, included spiked standards, repeat analyses, and extracted standards.

Table 6-1 summarizes the recoveries for the standard spikes from January through April, 1980. Figures 6-1 through 6-3 are plots of these recoveries for each of the fractions. The recoveries for the volatile organics averaged high during this period, although the plots indicate that a few extreme results covered the high average recoveries.

Table 6-2 summarizes the repeat analyses of random samples selected during the same period. The analytical standard deviations estimated from these repeat analyses ranged from 11 percent for acid analyses to 36 percent for VOAs.

Even more pertinent to this project is an analysis of the deuterated internal standards that were spiked into the samples analyzed in this contract. Percent recovery of the purgeable standards is summarized in Table 6-3. Similar data on the extractable standards is summarized in Table 6-4. Note that the solvent blank (Sample 5193) contained a positive interference for d_{35}-stearic acid.

6.2 Trace Element Quality Control

Blanks, duplicates, and certified standards were analyzed alongside the samples to provide quality control. The blanks were analyzed to provide data on possible contamination of the samples by the digestion methodology. They also provide background concentration levels of the metals in the solutions used in sample

TABLE 6-1. GC-MS QA STANDARDS REPORTED, JANUARY - APRIL, 1980

	Number of Standards	Number of Spikes	Average Recovery	Standard Deviation of Recoveries
Volatile Organics	8	37	137%	211%
Acid Fraction*	2	5	94%	28%
Base/Neutral Fraction	2	13	120%	69%
	3**	7	73%	59%

*Response factors for acid fraction were changed in February, 1980. Only standards analyzed after the change are reported here.

**Standards were first extracted then analyzed.

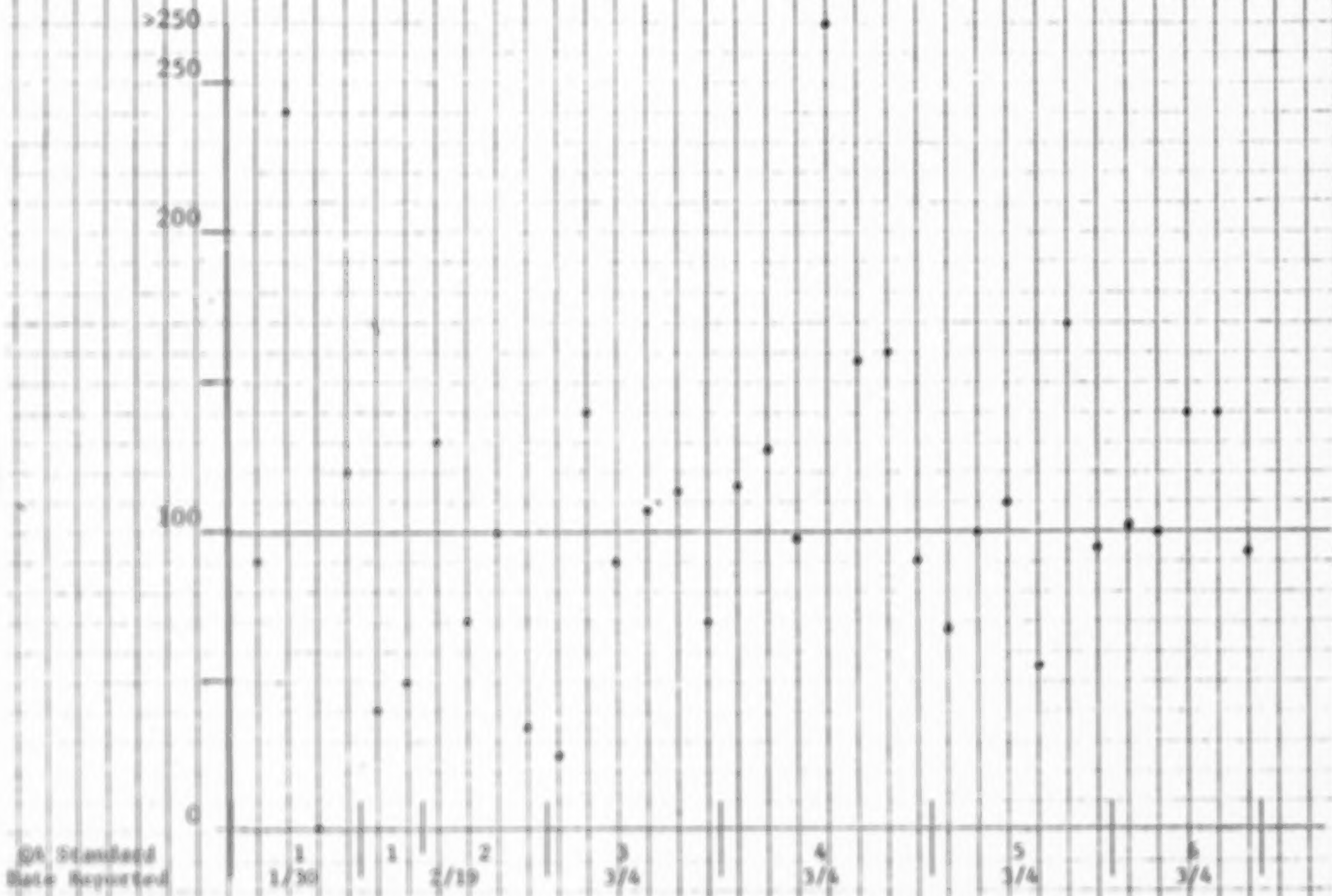

FIGURE 6-1. RECOVERIES FOR GC-MS VOA ANALYSES

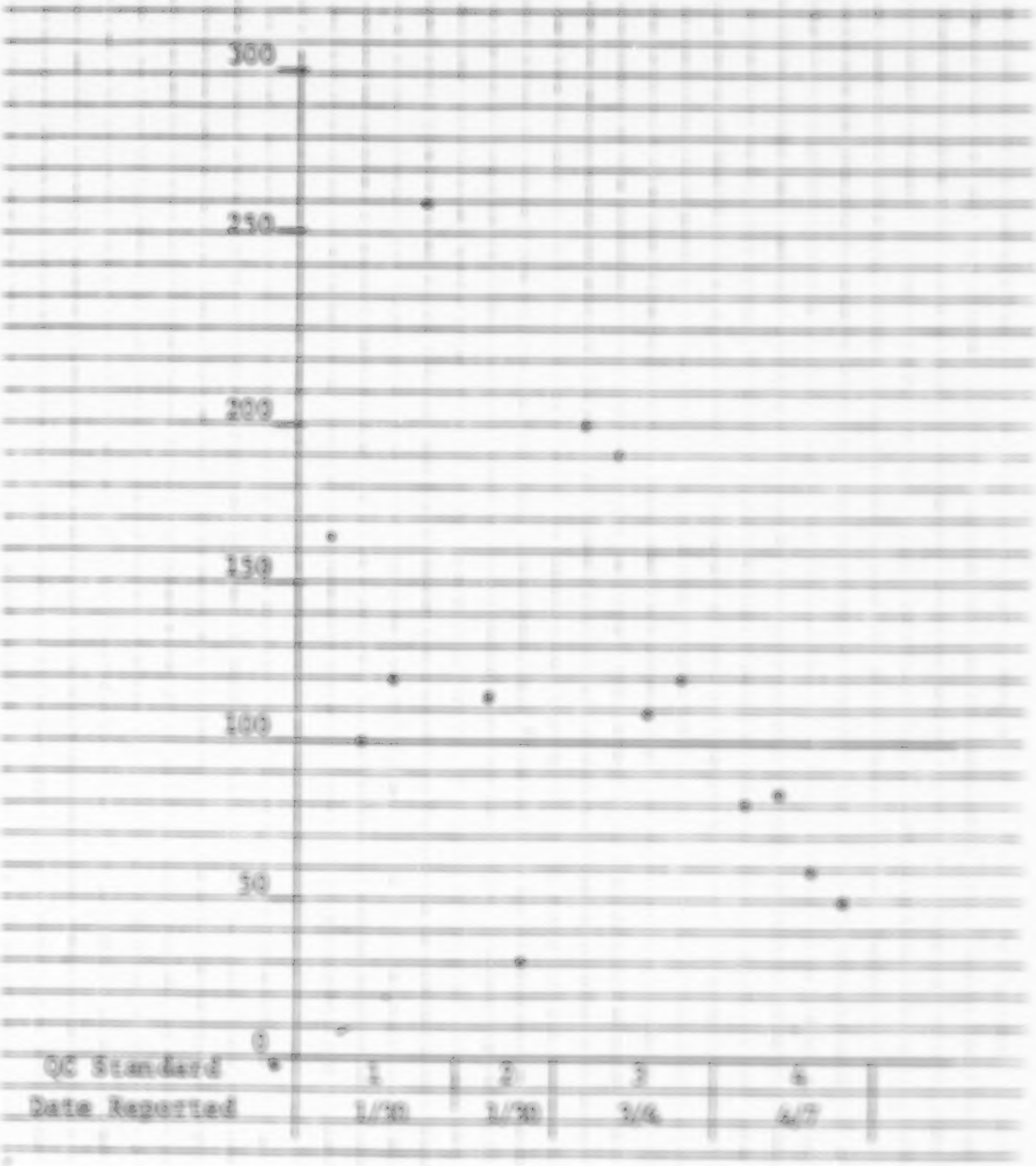

FIGURE 6-2. RECOVERIES FOR GC-MS B/N ANALYSIS

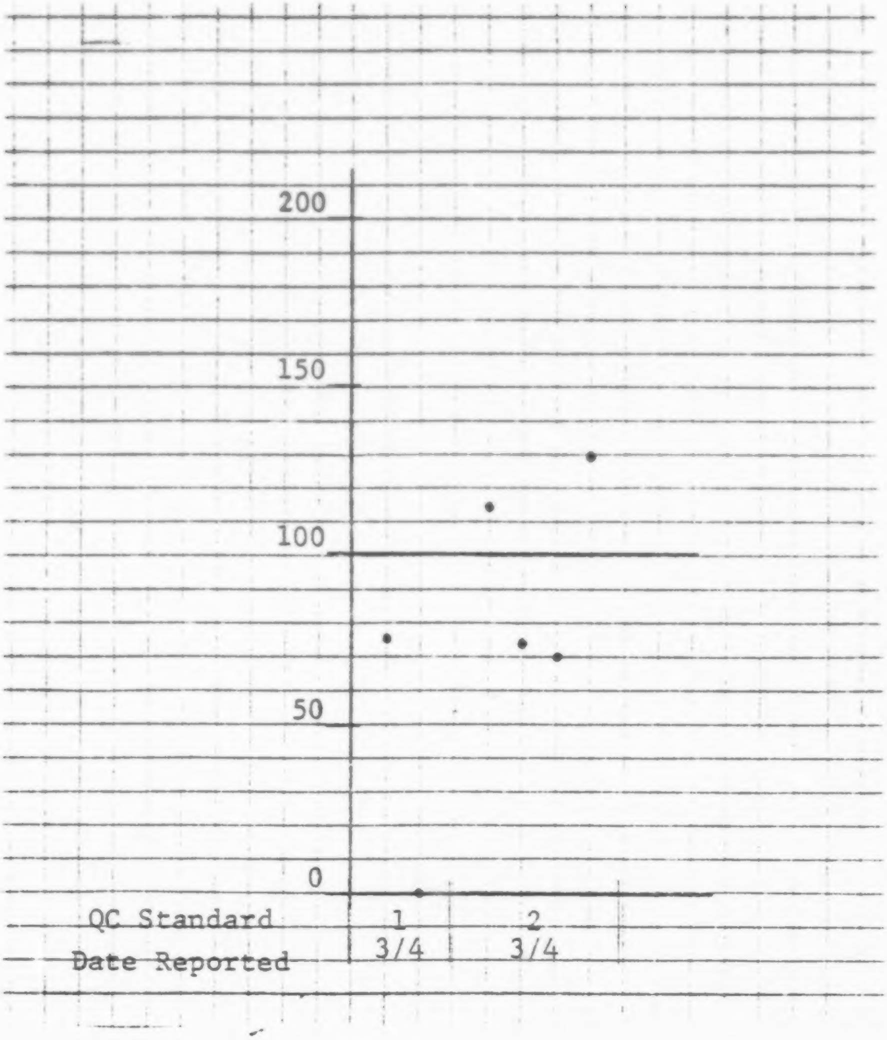

FIGURE 6-3. RECOVERIES FOR GC-MS ACID FRACTION ANALYSIS*

*Only standards analyzed after February change in response factor.

Table 6-2. GC-MS REPEAT ANALYSIS OF SAMPLES

	Number of Repeat Samples	Number of Analytes Reported in Both Analyses	Pooled Percent Difference[1]	Estimated Analytical Standard Deviation[2]	False Positives or False Negatives[3] Concentration (ppb)		
					Number	Average	Median
VOA	3	12	51%	36%	2[4]	2.6	2.6
Acid	2	2	15%	11%	4[5]	10.7	2.8
B/N	4	13	42%	30%	2	2.6	2.6

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[1] Percent Difference = $\frac{|\text{Original Analytical Concentration} - \text{Repeat Analytical Concentration}|}{|\text{Original Analytical Concentration} + \text{Repeat Analytical Concentration}|} \times 100$,

for original and repeat analysis both quantitated.

[2] Estimated Analytical Standard Deviation = $\frac{\text{Pooled Percent Difference}}{\sqrt{2}}$

[3] If either the original or repeated analysis is a nondetected value, the comparison is called either "false positive" or "false negative". The average and median concentration summarize the concentration of the detected analysis when an FP or FN occurs.

[4] Does not include a methylene chloride false positive which is a common laboratory contaminant.

[5] Includes a dimethyl phenol false negative at 36 ppb in a very dirty sample. The estimated detection limit for this analyte in this sample is greater than 20 ppb.

TABLE 6-3. RECOVERY OF VOLATILE ORGANIC SPIKES

Sample Number	Date Analyzed	Percent Recovery d_4-1,4-Dichloromethane	 d_6-Benzene	 d_8-Toluene
5083	3/27/80	102	116	108
5086	3/27/80	112	112	106
5081	3/25/80	110	118	114
5087	3/25/80	106	116	116
5082	3/25/80	114	114	110
5084	3/25/80	96	136	110
5085	3/27/80	120	134	136
5140	3/24/80	104	114	120
5141	3/23/80	114	134	126
5142	3/23/80	92	110	116
5134	3/24/80	124	116	114
5135	3/24/80	108	132	130
5136	3/14/80	104	80	94
5137	3/14/80	104	82	92
5138	3/13/80	NS	NS	NS
5156	3/24/80	102	106	90
5157	3/24/80	106	116	122
5158	3/23/80	100	142	140
5159	3/14/80	128	100	106
5160	3/13/80	NS	NS	NS
5143	3/30/80	188[1]	162[2]	154
5144	3/18/80	80	106	106
5145	3/18/80	90	86	100
5146	3/18/80	96	96	92
5147	3/17/80	104	100	98
5148	3/18/80	86	96	92
5149	3/30/80	100	130	124
5150	3/19/80	92	112	106
5151	3/18/80	104	122	138
5152	3/19/80	108	116	116
5153	3/19/80	84	112	122
5154	3/19/80	90	112	110
5155	3/19/80	86	126	114
5161	3/17/80	86	94	92
5162	3/15/80	130	106	122
5163	3/18/80	142	110	114
5164	3/15/80	132	116	122
5165	3/16/80	128	112	118
5166	3/16/80	116	126	138
5167	3/16/80	118	120	116
5168	3/16/80	106	100	98
5169	3/17/80	NS	96[2]	NS
	Average	106	112	112
	Standard Deviation	15	14	22

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[1] Value is an outlier on the basis of a T-test.

[2] Field spike; not included in summary statistics.

NS = Not Sampled.

TABLE 6-4. RECOVERY OF EXTRACTABLE SPIKES

Sample Number	Date Extracted	Date Analyzed	Spike (μg)	Percent Recovery Pentafluoro-phenol	d_8-Naphthalene	d_{35}-Stearic Acid
5067	2/26/80	4/12/80	20	90	60	18
5068	2/26/80	4/06/80	10	75	64	55
5069	2/27/80	4/12/80	50	56	64	4.4
5070	2/27/80	4/02/80	10	78	58	17
5071	2/27/80	4/06/80	10	51	67	20
5072	2/28/80	4/08/80	20	34	55	ND <5
5073	2/28/80	4/06/80	20	46	55	ND <5
5125	3/06/80	4/02/80	50	44	68	7.8
5126	3/06/80	4/02/80	20	32	48	9.5
5127	3/06/80	4/02/80	10	39	58	ND <5
5120	3/05/80	4/18/80	50	50	46	15
5121	3/05/80	4/01/80	20	270[1]	32	18
5122	3/05/80	4/01/80	10	54	61	35
5123	3/05/80	4/01/80	20	50	65	70
5124	3/05/80	4/01/80	10	40	51	91
5129	3/06/80	4/02/80	50	28	42	6.2
5130	3/06/80	4/08/80	20	29	43	12
5131	3/06/80	4/02/80	10	31	48	16
5132	3/06/80	4/11/80	20	36	60	60
5133	3/06/80	4/12/80	10	26	48	76
5171	3/07/80	3/24/80	20	45	45	10
5172	3/07/80	4/02/80	10	63	42	ND <5
5173	3/07/80	4/02/80	50	36	40	ND <5
5174	3/07/80	4/07/80	50	28	56	9.2
5175	3/07/80	4/06/80	20	75	85	ND <5
5176	3/07/80	3/24/80	20	65	50	48
5177	3/08/80	4/02/80	10	54	54	72
5128	3/06/80	4/02/80	200	44	60	20
5178	3/08/80	4/07/80	50	38	58	3.2
5179	3/08/80	3/24/80	20	65	60	50
5180	3/08/80	4/09/80	50	58	50	4.4
5181	3/08/80	4/07/80	20	28	30	12
5182	3/08/80	4/04/80	10	38	67	39
5183	3/08/80	4/06/80	50	44	38	ND <5
5184	3/08/80	3/2/80	20	38	30	ND <5
5185	3/08/80	4/1/80	10	35	32	ND <5
5186	3/08/80	4/1/80	20	55	40	ND <5
5187	3/09/80	4/2/80	10	21	27	35
5188	3/09/80	3/2/80	20	15	34	7.5
5189	3/09/80	4/0/80	10	77	110	ND <5
5190	3/09/80	4/0/80	10	36	58	44
5191	3/09/80	4/0/80	0	--	--	--
5192[2]	---	4/0/80	20	70	80	165
5193	---	4/0/80	0	---	---	(26)[4]
		Aveage[3]		46	53	22
		Stadard Deviation		17	16	25

---

[1] Value is an outlier on te basis of a T-test.

[2] Analysis of spiking soluion. Values not included in calculations.

[3] For compounds not detectd, one-half of the reported value was used for calculating the average.

[4] False positive result; ecovery calculated on the basis of a 10-μg spike.

preparation. Ten percent of the samples were analyzed in duplicate to provide repeatability data. Finally, certified standards were also analyzed alongside samples to provide accuracy data. The results of these quality control analyses are presented in Table 6-5.

TABLE 6-5. QUALITY CONTROL DATA FOR PULP MILL SAMPLES*

Sample Number	Concentrations in µg/ℓ											
	Sb	As	Be	Cd	Cr	Cu	Pb	Ni	Se	Ag	Tl	Zn
4910-1	<3	6	<0.5	1.3	23	18	3	58	<4	0.5	<2	150
-2	<3	5	<0.5	1.2	23	14	5	140	<4	0.7	<2	150
4920-1	<3	<2	<0.5	0.8	5	4	<1	<5	<4	<0.5	23	110
-2	<3	<2	<0.5	1.5	4	4	<1	<5	<4	<0.5	12	110
4924-1	<3	<2	<0.5	1.9	10	37	2	<5	<4	<0.5	<2	550
-2	<3	<2	<0.5	2.1	10	38	2	<5	<4	<0.5	<2	490
4939-1	<3	3	<0.5	0.6	24	5	<1	<5	<5	<0.5	25	110
-2	<3	3	<0.5	0.6	25	4	<1	<5	<4	<0.5	20	110
					Certified Standards							
Radian	--	27	17	5.1	15	18	24	40	5.0	--	--	13
Certified	--	26	16	5.2	16	16	22	26	5.2	--	--	11

GLOSSARY

absorb: To suck up, drink in.

activate: To make capable of reacting or of accelerating a chemical reaction.

adsorption: Adhesion of the molecules of a gas, liquid, or dissolved substance to a surface.

aliphatic: Of or obtained from fat, specifically, of or belonging to a class of carbon compounds, especially the saturated or unsaturated compounds, in which the carbon atoms are joined in open chains.

aromatic: Of or designating a derivative of benzene or a compound whose molecule contains one or more benzene rings.

biochemical oxygen demand: The amount of oxygen required by bacteria while stabilizing decomposable organic matter under aerobic conditions.

black liquor: The residual liquor left after wood chips are cooked with chemicals in a digester. Composed of residual chemicals and all dissolved materials derived from the wood during cooking.

chelate: A chemical compound in which the central atom (usually a metal ion) is attached to neighboring atoms by at least two bonds in such a way as to form a ring structure.

chemical oxygen demand: A measure of the oxygen equivalent of the organic fraction in the sample which is susceptible to permanganate or dichromate oxidation in an acid solution.

conventional pollutants: Biochemical oxygen demand, total suspended solids, pH, oil and grease, and fecal coliform.

decker or washer: A rotary drum filter which is used to thicken or wash wood pulp.

demineralization: The process of removing mineral compounds from a wastestream.

desorption: The removal of an adsorbed or absorbed material by a chemical or physical process.

electrodialysis: The rapid removal of undesired ions from solution by the application of a direct current to electrodes inserted into a dialysis system.

elute: To remove adsorbed material by use of a solvent.

empirical: Relying or based on practical experience without reference to scientific principles.

flocculation: To collect (soils, clouds, precipitates, etc.) into small fluffy masses.

humic acid: A brown powder consisting of organic acids, derived from humus.

hydrophilic: Capable of uniting with or taking up water.

head loss: frictional loss in a system, expressed as feet of water.

kappa number: A measure of the delignification of pulp.

lignin: An amphorous, cellulose-like, organic substance which acts as a binder for the cellulose fibers in wood and certain plants and adds strength and stiffness to the cell walls.

macromolecule: A very large molecule containing hundreds or thousands of atoms, such as a polymer molecule. Colloidal particles are often referred to as macromolecules.

moles: The quantity of a chemical substance having a weight in grams numerically equal to its molecular weight: a mole of a substance contains 6.02257×10^{23} molecules.

mutagen: Any agent or substance capable of noticeably increasing the frequency of mutation.

non-conventional pollutants: Industry-specific compounds not considered priority (toxic) or conventional pollutants.

oxidize: To remove electrons from an atom or ion.

pH: A symbol for the degree of acidity or alkalinity of a solution.

precipitate: To cause a slightly soluble compound to become insoluble and separate out of solution.

priority pollutants: Sixty-five classes of pollutants defined as toxic in a settlement agreement between EPA and the National Resource Defense Council, Inc.

recovery furnace: A furnace and boiler designed to burn the concentrated black liquor. High pressure steam and a molten slag containing recovered cooking chemicals are generated in this process.

reverse osmosis: A method of extracting essentially pure, fresh water from polluted or salt water by forcing the water under pressure against a semipermeable membrane, which passes the pure water molecules and filters out salts and other dissolved impurities.

smelt (slag): The molten chemicals resulting from combustion of the black liquor in the recovery furnace containing primarily sodium carbonate and sodium sulfide.

soda loss: Losses of the sodium based cooking chemicals in washing, recovery, and cooking liquor preparation. Expressed as a loss per ton of production using a common base, i.e., Na_2O.

spike: A known concentration of a compound added to a sample to determine the recovery efficiency obtainable from a given piece of equipment.

surrogate compound: An atomically tagged compound used as a spike to determine recovery. This compound is readily identifiable from others in the solution when the results are analyzed.

thermal regeneration: To restore to its original state by the use of heat energy.

toxic: acting as a poison, poisonous.

verification list: A listing or priority and non-conventional pollutants.

white liquor: The liquor used in cooking wood chips. Composed of sodium hydroxide, sodium sulfide and sodium carbonate. Only the first two are effective in the digestion or cooking operation.

C: This symbol represents the chlorination stage in the bleachery. Chlorine gas or chlorine water is reacted with the pulp to remove residual liquor.

E_1: This symbol represents the first extraction stage in the bleachery. The pH is reversed (to the caustic side) and the lignin is removed in subsequent washing operations.

H: This represents the hypochlorite bleaching stage in which hypochlorite is used for additional bleaching.

D_1: This represents the first chlorine dioxide bleaching stage where chlorine dioxide is used for bleaching.

E_2: The second extraction stage. See E, above.

D_2: The second dioxide stage. See D, above.